Jurnal Amal Pendidikan
ISSN-p 2746-4725 | ISSN-e 2721-3668
Vol. 5, No. 1, April 2024, Hal: 60-74, Doi: http://doi.org/10.36709/japend.v5i1.125
Available Online at https://japend.uho.ac.id

Analysis of Mathematical Reasoning Abilities Based on PISA Number Content

Cici Imelda Sabri. L [1)], Salim [1)] *

[1]Department of Mathematics Education, Universitas Halu Oleo. Kota Kendari, Indonesia.

Received: 01 April 2024 *Revised: 15 April 2024* *Accepted: 30 April 2024*

Abstract

This study aims to determine the mathematical reasoning abilities of eighth-grade students at SMP Negeri 1 Kulisusu Utara in solving PISA-based mathematics problems in the content of numbers. This research is a qualitative descriptive study. The subjects of this study were 3 students from class VIIIB at SMP Negeri 1 Kulisusu Utara, conducted during the 2020/2021 academic year. Data collection techniques included tests, interviews, and documentation. The data analysis technique used was descriptive analysis, employing the theory of Miles, Huberman, and Saldana, which involves data condensation, data presentation, and drawing conclusions. The results of the study indicated that: Students with high mathematical abilities in solving PISA number content problems were found to have high mathematical reasoning abilities. Students with moderate mathematical abilities in solving PISA number content problems were found to have moderate mathematical reasoning abilities. Students with low mathematical abilities in solving PISA number content problems were found to have moderate mathematical reasoning abilities.

Keywords: numbers; reasoning ability; pisa.

INTRODUCTION

Facing the era of the Industrial Revolution 4.0, it is essential to have human resources (HR) who are creative, critical, innovative, and willing to collaborate effectively. This is clearly more likely to be produced by educational institutions such as schools. Schools are educational institutions that encompass all knowledge and perform educational functions. One of the components in schools is the subject of mathematics. Mathematics is a field of knowledge taught at various educational levels, from elementary school, junior high school, senior high school, to higher education. Mathematics is studied in schools as a core subject and is also one of the national exam subjects. Whether we realize it or not, mathematics activities are an integral part of our daily lives.

Reasoning ability is one of the factors that every student must master and develop in learning mathematics. Reasoning is a high-level thinking pattern that includes the ability to think logically and systematically. English, as cited in (Susilowati, 2016), states that “The traditional view of mathematical reasoning as superior computational and analytical skills has been revised to accommodate processes that are important in today’s knowledge-based era. These include gathering evidence, analyzing data, making conjectures, constructing arguments, drawing and validating logical conclusions, and proving assertions.” This means that mathematical reasoning is not just about computational and analytical skills but also involves several processes, such as gathering evidence, analyzing data, making conjectures, constructing arguments, drawing conclusions, validating logical conclusions, and proving the truth of statements decisively. Mathematical reasoning also includes the development, justification, and use of mathematical generalizations that lead to the connection of mathematical knowledge

* Author Correspondence. E-mail: salim@uho.ac.id
Publisher: FKIP Universitas Halu Oleo

within the field of mathematics. This implies that mathematical reasoning always utilizes the existing knowledge and rules in mathematics.

If reasoning ability in mathematics is not mastered and developed, mathematics will only become a subject that follows procedures and a series of examples previously given by the teacher without understanding the meaning. Setiadi, as cited in (Putri, Sulianto, & Azizah, 2012), states that reasoning can directly improve students' learning outcomes, particularly when students are given the opportunity to use their reasoning skills to make predictions based on their own experiences, making it easier for them to understand concepts. This aligns with opinion (Inayah's, 2016) that the higher the level of reasoning possessed by students, the faster the learning process will be to achieve learning indicators. Shadiq, as cited in (Rosaliana, Muhtadi, & Setiawati, 2019), argues that reasoning ability is not only needed by students when they are learning mathematics or other subjects, but it is also essential for everyone when solving problems or making decisions. Mathematical reasoning is a crucial skill that every student must possess to solve complex problems in everyday life.

However, in reality, students' mathematical reasoning ability is still low. This is evident from the results of studies conducted by PISA. In 2003, a study by the Student Assessment (PISA) showed that Indonesia ranked 38th out of 40 countries. In 2006, Indonesia ranked 50th out of 57 countries. In 2009, Indonesia ranked 60th out of 65 countries. In 2012, Indonesia's ranking became even more concerning, as the country ranked 64th out of 65 countries (Wijaya, Fahinu, & Ruslan, 2018). In 2015, Indonesia remained in the bottom 10, ranking 64th out of 72 participating countries (Alifin, Kodirun, & Ikman, 2018). In 2018, Indonesia was ranked 74th out of 79 countries, or sixth from the bottom (OECD, 2019). One of the competencies assessed in the PISA study is mathematical reasoning ability (OECD, 2015). To improve students' mathematical reasoning ability, it is necessary to provide problems that require a sufficiently high level of reasoning to solve. PISA problems are one such example. According to (Wardhani & Rumiati, 2011), PISA problems demand more reasoning, problem-solving, and argumentation skills. Furthermore, PISA problems do not merely require the ability to apply concepts, but they also emphasize how a concept can be applied in various situations (Kurniati, Harimukti, & Jamil, 2016). A student is said to be able to solve a problem if they can apply the knowledge they have previously acquired to new, unfamiliar situations, including how they predict the answer to the problem.

PISA problems are developed in four content areas: shape and space, change and relationships, quantity, and uncertainty and data. The results of the 2012 PISA study, which focused primarily on mathematical literacy, showed that Indonesia scored an average of 384 in PISA problems related to shape and space (OECD, 2014), an average of 364 in problems related to change and relationships (OECD, 2014), an average of 384 in problems related to uncertainty and data (OECD, 2014), and an average of 362 in problems related to quantity (OECD, 2014). In the PISA number content, Indonesia received the lowest average score compared to the PISA content areas of change and relationships, uncertainty and data, and shape and space. Indonesia also ranked last in the PISA number content among all participating countries (OECD, 2014). The problems in the quantity content area focus on the relationships and patterns of numbers. This includes the ability to reason quantitatively, represent something with numbers, understand mathematical steps, perform mental calculations, and make estimates (Anisah, Zulkardi, & Darmawijoyo, 2011). According to (Bahar et al., 2020), the number content is the most challenging and essential aspect of mathematics in life, and problems in this content area are most commonly applied in everyday life, such as currency exchange, determining bank interest rates, shopping, calculating taxes, measuring time, measuring distance, and so on. Therefore, PISA number content problems are very suitable to be used as an alternative to measure and improve students' mathematical reasoning abilities.

According to (Wardani & Rumiati, 2011) revealed that many weaknesses in Indonesian students' mathematical abilities were exposed in the PISA study. Generally, students' weaknesses include not yet being able to develop their reasoning abilities, not having the habit of reading while thinking and working to understand essential and strategic information in solving problems, and still tending to receive information and then forget it, so mathematics has not yet become a means of thinking for students.

In an interview conducted by the researcher with a mathematics teacher at SMP Negeri 1 Kulisusu Utara, the teacher mentioned that students experience several difficulties in solving word problems, such as those in PISA. Students are still confused about making conjectures and performing mathematical manipulations when solving problems. When asked to solve problems, students are unable to provide the correct reasoning or evidence for their results and cannot draw conclusions from true statements. Reasoning ability is closely related to problem-solving ability. In addition to being related to problem-solving ability, reasoning ability is also related to mathematical ability. According to Megawati, as cited in (Azizah, Sunardi, & Kurniati, 2017), students' mathematical abilities influence their reasoning abilities. Students with high mathematical abilities fall into the category of students with excellent reasoning abilities, students with moderate mathematical abilities tend to have fairly good reasoning abilities, while students with low mathematical abilities tend to have poor reasoning abilities (Mualifah & Lukito, 2014). Therefore, the higher a person's mathematical ability, the higher their level of reasoning ability.

Based on the discussion of mathematical reasoning, PISA results, school conditions, and previous research on PISA, the researcher aims to delve deeper into the mathematical reasoning abilities of eighth-grade students at SMP Negeri 1 Kulisusu Utara in solving PISA number content problems. Gardner, et al., as cited in (Lestari & Yudhanegara, 2015), stated that mathematical reasoning is the ability to analyze, generalize, synthesize, integrate, provide proper reasoning, and solve non-routine problems. According to Putra & Hartono, as cited in (Pangesti, 2018), mathematical reasoning is the thinking process used to determine whether a mathematical argument is correct or incorrect and to construct new mathematical arguments.. The research conducted by (Dewi, 2018) concluded that (1) students with high abilities meet the indicators of making conjectures, performing mathematical manipulations, constructing proof, providing reasoning or evidence for several solutions' correctness, drawing conclusions from a statement, and checking the validity of an argument; (2) students with moderate abilities meet the indicators of making conjectures and checking the validity of an argument; (3) students with low abilities meet the indicator of making conjectures. The similarity between previous research and this study lies in the students' mathematical reasoning abilities in solving mathematical problems. The difference is that previous research used curriculum-based problems, while this study uses PISA number content-based problems.

The aim of this research is to determine the mathematical reasoning abilities of eighth-grade students at SMP Negeri 1 Kulisusu Utara in solving PISA-based mathematics problems on number content. This research is beneficial in helping students detect their reasoning abilities so that they can adjust their learning methods according to their abilities and serves as a source of knowledge in solving PISA-based mathematics problems on number content..

METHODS

This research is a qualitative descriptive study. The aim of this research is to determine the mathematical reasoning abilities of eighth-grade students at SMP Negeri 1 Kulisusu Utara in solving PISA-based mathematics problems in the number content area. The research was conducted at SMP Negeri 1 Kulisusu Utara with class VIIIB. The subjects of this study were three students from class VIII B at SMP Negeri 1 Kulisusu Utara, consisting of one student with low mathematical ability, one with moderate mathematical ability, and one with high mathematical ability.

In qualitative research, the main instrument or primary research tool is the researcher themselves. However, in this study, additional instruments were also used as complements or supporting tools, including tests, interview guidelines, and documentation. The mathematical reasoning ability test was based on the material under investigation, specifically related to the PISA quantity or number content test. The test in this study was taken from the PISA released mathematics items published by the OECD, ensuring that the test administered met PISA standards, and therefore, reliability testing was not necessary. In this study, the test administered consisted of two themes with three questions: one low-level question from the "Driver" theme question 1, one medium-level question from the "Driver" theme question 1, and one high-level question from the "Mount Fuji" theme question 2. The test included two multiple-choice questions and one essay question. For the multiple-choice questions, students were also instructed to write down their solution process to facilitate the researcher's analysis.

Interview guidelines were prepared to ensure the interview process remained focused on the research objectives. The guidelines were designed to support the test results. Data collection through interviews was conducted using structured interviews based on the PISA questions administered. The documentation instruments used in this research included documents such as photos of activities, initial test results of class VIII B students, mathematical reasoning test results, and interview transcripts. In this study, the data collection methods employed were tests, interviews, and documentation. The tests included in this research were of two types: a preliminary mathematical ability test and a mathematical reasoning ability test. The mathematical ability test was administered to group students based on their mathematical abilities. This test was taken from the Junior High School Mathematics National Exam (UNBK) package 1, consisting of 20 questions covering material already studied by the eighth-grade students being studied. The selected questions were multiple-choice with four answer options, while the mathematical reasoning ability test was used to measure students' mathematical reasoning abilities in solving PISA-based mathematics problems in the number content area. The mathematical reasoning ability test consisted of three questions selected from PISA Released Mathematics Items. The interview was conducted to gather more detailed information from students about their thought processes and actions when solving the mathematical reasoning test based on PISA number content. The documentation method in this research was used to obtain school data and student identity information, such as the list of names, the atmosphere during the test, and the interviews.

Data analysis in this study was carried out during the research process until the completion of data collection, to make it more systematic and no data was forgotten so that it made it easier for researchers to interpret it. Through student work, researchers can see students' reasoning skills in solving problems. Assessment of students' mathematical reasoning ability is seen from the percentage of student scores calculated through the formula:

$$Percentage = \frac{score\ obtained}{score\ maksimum} \times 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

The levels of mathematical reasoning ability are as follows:

Table 1 Categories of Achievement of Students' Mathematical Reasoning Ability

Category	Achievement of Students' Mathematical Reasoning Ability
High	$> 70\%$
Medium	$50\% \leq P \leq 70\%$
Low	$< 50\%$

(Suprihatin, Maya & Eka, 2018)

According to (Miles, Huberman & Saldana, 2014) suggest three stages that must be done in analyzing qualitative research data, namely (1) data condensation; (2) data presentation; (3) conclusion drawing/verification. The data condensation process also aims to avoid the accumulation of the same data or information from students. In this study, data on students' reasoning ability will be obtained which will be further explored using the interview method. Data on valid research will be presented in the form of narrative to describe the mathematical reasoning ability of students with moderate ability. Data on valid research will be presented in the form of narrative to describe the mathematical reasoning ability of students with moderate ability. The data validity check used in this research is triangulation. The type of triangulation used is triangulation technique, in this study triangulation technique carried out by checking and comparing data by observing students' mathematical reasoning ability, namely comparing the results of mathematical reasoning ability tests and interview results so that it will get valid data.

RESULTS AND DISCUSSION

This research was conducted with 3 stages, namely math ability tests, mathematical reasoning tests and interviews. After the math ability test was conducted, the subject selection was carried out by paying attention to the results of the math ability test and teacher consideration. From the test results and teacher consideration, 3 research subjects were obtained to be given mathematical reasoning tests and interviewed. Analysis of mathematical reasoning ability of subjects with high initial mathematical ability as follows:

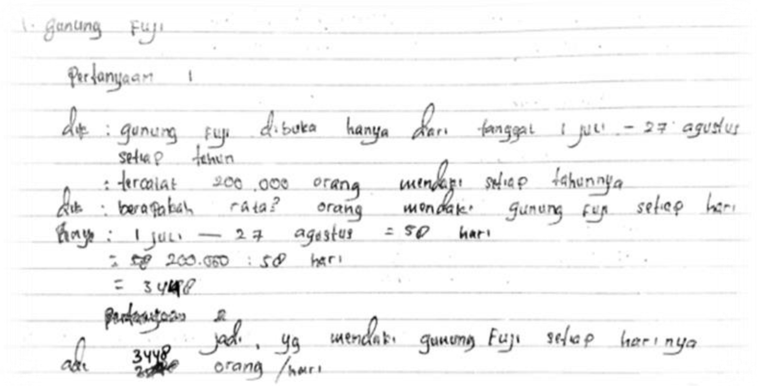

Figure 1. S13's answer to Mount Fuji theme question 1

Figure 1 shows that students are able to write down what information is contained in question number 1 and write it correctly. S13 was able to estimate the way to solve the question 1 fuji mountain theme but was not able to write it completely on the answer sheet. S13 was able to organize the steps of working quite well. Seen on the answer sheet, to find the average number of people who climb Mount Fuji per day is dividing 200,000÷58. However, the student did not provide information on the answer sheet for what 200,000÷58 was being sought. S13 was able to conclude the statement well according to the steps he used. This is supported by the results of the interview as follows:

P : Do you understand this question number 1?
S13 : Understood kak
P : What is known from question number 1?
S13 : What is known is that Mount Fuji is only open from July 1 to August 27 each year and 200,000 people climb it each year.
P : Then what is being asked?
S13 : What is the average number of people climbing Mount Fuji every day?
P : What do you need to do to solve this problem?

S13 : First, we need to find the number of days between July 1 and August 27 and I found the result to be 58.
P : Where did you get the 58 days from
S13 : Well kak, in July there were only 31 days then I added up with 27 days in August and I got 58 days kak.
P : Then, is there another way or not to solve it?
S13 : Then kak to find the average number of people climbing each year I divided the number of people who climbed the number of days between July 1 - August 27.
P : Okay. Now what are the calculation steps that you did in solving the problem?
S13 : 200.000÷58
P : So, the meaning of 200,000÷58 is to calculate the average number of people who climb Mount Fuji?
S13 : Yes, but I forgot to write it on my answer sheet.
P : Okay, that's okay. Then how many results did you get
S13 : The result is 3448.2
P : What is the conclusion of the question?
S13 : So, 3448 people climb Mount Fuji every day.

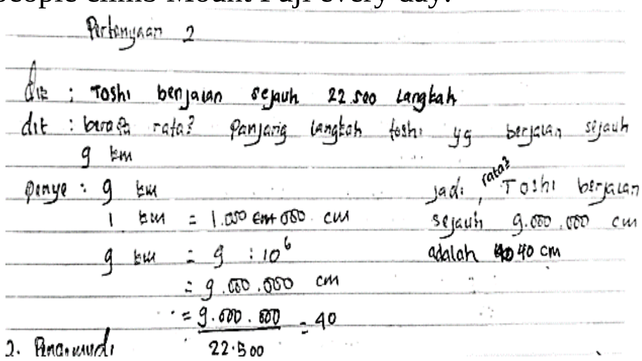

Figure 2. S13's answer to Mount Fuji theme question 2

Based on Figure 2, S13 was able to accurately write down the information provided in the question and correctly identify the elements that were known and asked. S13 was able to estimate the method for solving question 2 on the Mount Fuji theme but was not able to fully write it down on the answer sheet. S13 successfully organized the steps for solving the problem. This is evident from the answer sheet, where to find the average length of Toshi's stride, S13 correctly divided 900,000 by 22,500. However, S13 did not provide an explanation on the answer sheet as to what the 900,000 divided by 22,500 calculation represented. S13 was able to conclude the statement appropriately based on the steps they followed. This is supported by the following interview results:

P : Okay now look at the Mount Fuji theme question 2. Do you understand the question?
S13 : I understand quite well, sis.
P : What is known from the question?
S13 : What is known is that toshi walked 22,500 steps.
P : What is being asked?
S13 : what is the average step toshi walked for 9 km.
P : Try now to explain, what method do you use to work on the problem!
: The trick is that kak we divide the number of toshi steps by the distance toshi walks.
S13
P : Is that all?
S13 : Emmm but before that the unit of 9km must first change the unit to cm.
P : Okay. Now what are the calculation steps you took in solving the problem?

S13 : 9.000.000÷22.500
P : what is the result you get
S13 : the result is kak,40
P : What is the conclusion of the problem?
S13 : So the average toshi walked 9,000,000 cm is 40 cm.

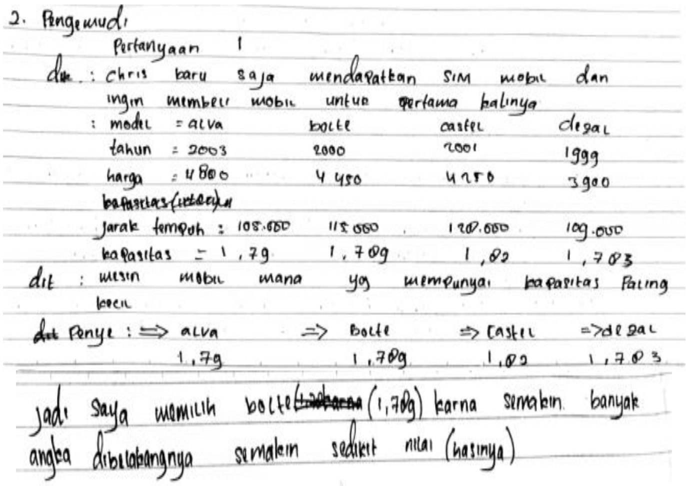
2. Pengemudi
Pertanyaan 1
dik : Chris baru saja mendapatkan SIM mobil dan ingin membeli mobil untuk pertama kalinya
: model = alva bolte castel desal
tahun = 2003 2000 2001 1999
harga = 4800 4450 4250 3900
kapasitas(...)
Jarak tempuh : 105.000 115.000 128.000 109.000
kapasitas = 1,79 1,789 1,82 1,783
dit : mesin mobil mana yg mempunyai kapasitas paling kecil
Penye : => alva => bolte => castel => desal
1,79 1,789 1,82 1,783
jadi saya memilih bolte (1,789) karna semakin banyak angka dibelakangnya semakin sedikit nilai (hasinya)

Figure 3. S13's answer to Driver Theme Question 1

Based on Figure 3, S13 was able to gather and present information by correctly rewriting the known elements and identifying what was being asked in the question. However, S13 was unable to explain the steps taken to solve the mathematical problem. In solving the problem, S13 could not organize the steps and did not perform any calculations. S13 was able to write a conclusion, but it was incorrect. This is supported by the following interview results:

P : How about the driver theme question 1. Did you understand it?
S13 : Understand anyway sis
P : If you understand what is known in the question?
S13 : Crish just got a car license and wants to buy a car for the first time. In the question there are 4 choices of cars, the first is Alva, the year is 2003, the price is 480, the mileage is 105,000 and the capacity is 1.79. The second is the bolte model, the year is 2000, the price is 4450, the mileage is 115,000 and the capacity is 1.789, the third model is castel, the year is 2001, the price is 4250, the mileage is 128,000 and the capacity is 1.82 and the last is the desal model, the year is 1999, the price is 3900, the mileage is 109,000 and the capacity is 1.783.
P : What is the question?
S13 : Which car engine has the smallest capacity
P : What is needed to solve this problem?
S13 : hmmm..., confused kak
P : But, here you wrote your conclusion, how did you get that conclusion?
S13 : I immediately used logic and I chose bolte which has the smallest car capacity, because bolte has a capacity of 1,789 and the more numbers behind the comma, the smaller the value.
P : Then what is the conclusion of this problem
S13 : So, the smallest car capacity is a bolte car

To find out the level of mathematical reasoning ability of subject S13, the researcher calculated the score obtained by S13 in solving the problem, the following are the results of the calculation of S13's score

$$\text{TKPM}_{S13} = \frac{\text{score obtained}}{\text{score Maksimum}} \times 100\%$$
$$\text{TKPM}_{S13} = \frac{27}{33} \times 100\%$$
$$\text{TKPM}_{S13} = 81{,}8\%$$

From the results of the analysis of the scores obtained by subject S13 above, it can be concluded that the level of mathematical reasoning ability of subject S13 is classified as high category. Analysis of the mathematical reasoning ability of subjects with moderate initial mathematical ability as follows:

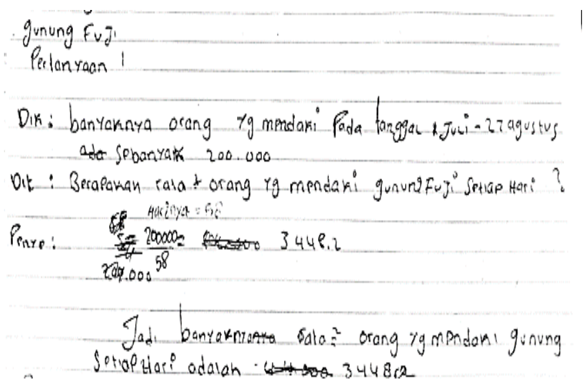

Figure 4. S13's answer to Mount Fuji Theme Question 1

Based on Figure 4, S15 was able to collect and present information by rewriting the known elements and writing what was asked from the problem correctly. S15 was able to estimate the way to solve the question 1 fuji mountain theme but was not able to write it completely on the answer sheet. S15 was able to organize the steps of working well. Seen on the answer sheet, to find the average person who climbs Mount Fuji every day is dividing 200,000/58. However, S15 did not provide information on the answer sheet for what 200,000/58 is looking for. S15 was able to rewrite the statement from the calculation results and relate it to the statement in the problem. This is supported by the following interview result:

P : Do you understand the Mount Fuji theme question 1?
S15 : Understood kak
P : What is known in the question?
S15 : It is known that the number of people who climbed on July 1 - August 27 was 200,000.
P : Then what is asked?
S15 : Asked how many people climb Mount Fuji on average every day?
P : How do you do the problem?
S15 : To get the average number of people climbing Mount Fuji, I counted the days and then divided them.
P : How did you calculate the number of days?
S15 : I added 31+27 kak
P : Okay. Now what are the calculation steps you took in solving the problem?
S15 : I calculated 200,000/58
P : So, the meaning of 200,000/58 is to calculate the average number of people who climb Mount Fuji?
S15 : Yes, sis.
P : Then, how many results did you get
S15 : The result is 3448.2
P : So what is the conclusion of the question?

S15 : So, the average number of people who climb the mountain every day is 3448.

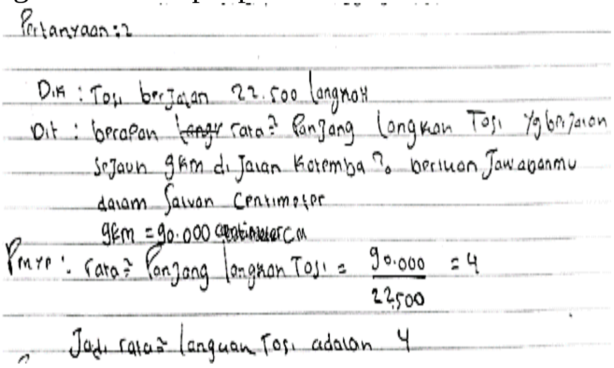

Figure 5. S15's answer to Mount Fuji theme question 1

Based on Figure 5, S15 was able to write down what information was contained in the question 2 of the theme of Mount Fuji and rewrite the known elements and write down what was asked from the question correctly. S15 was able to estimate the way to solve the question of the theme of Mount Fuji question 2 and wrote it on the answer sheet. However, the results are still not correct. . S15 was able to organize the steps of working quite well. The steps he used were correct but the results were less precise. S15 was able to conclude the statement well according to the steps he used but the results were less precise..

Hal ini sejalan dengan hasil wawancara sebagai berikut:

P : What is known in Mount Fuji theme question 2?
S15 : It is known that toshi walked 22,500 steps
P : Then what is being asked?
S15 : What is asked is what is the average length of footsteps of toshi who walked 9 km on the sewer road? In units of cm
P : Try to explain now, what method do you use to do the question?
S15 : First I changed the unit 9km to cm and I got 90,000 cm. then to find the average length of toshi's footsteps I divided 90,000 cm by 22,500.
P : What are the calculation steps you took in solving the problem?
S15 : Average tosi footstep length = 90,000/22,500=4
P : Then what is the conclusion of the problem?
S15 : So the average length of toshi's footsteps is 4 cm.

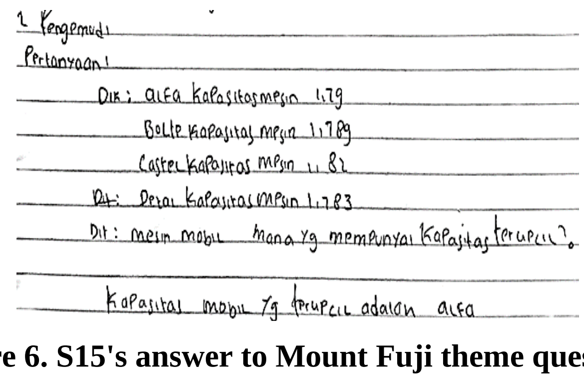

Figure 6. S15's answer to Mount Fuji theme question 1

Based on Figure 6, S15 was able to understand the driver theme question 1 well. On the answer sheet, S15 was able to rewrite the known elements and write down what was asked from the problem correctly. S15 was unable to explain the steps taken to solve the math problem. S15 in solving the problem was not able to compile the steps and did not do the calculations well. S15 students are able to write conclusions but are not precise. This is supported by the results of the interview as follows:

P : Next is the driver theme question 1, what is known from the question?
S15 : It is known that alpha engine capacity is 1.79 bolte engine capacity is 1.789, castel engine capacity is 2.82 and delta engine capacity is 1.783.
P : What is the question?
S15 : Which car engine has the smallest capacity?
P : What is needed to solve problem number 3?
S15 : I don't know how to do it.
P : But, here you wrote your conclusion, how did you get that conclusion?
S15 : I just chose it, I guessed.
P : Then what is the conclusion of this problem
S15 : So, the smallest car capacity is alpha car

To find out the level of mathematical reasoning ability of subject S15, the researcher calculated the score obtained by S15 in solving the PISA number content question, the following are the results of the calculation of S15's score

$$\text{TKPM}_{S15} = \frac{\text{score obtained}}{\text{score maksimal}} \times 100\%$$

$$\text{TKPM}_{S15} = \frac{23}{33} \times 100\%$$

$$\text{TKPM}_{S15} = 69{,}7\%$$

From the results of the analysis of the scores obtained by subject S15 above, it can be concluded that the level of mathematical reasoning ability of subject S15 is classified as moderate. Analysis of mathematical reasoning ability of subjects with high initial mathematical ability as follows:

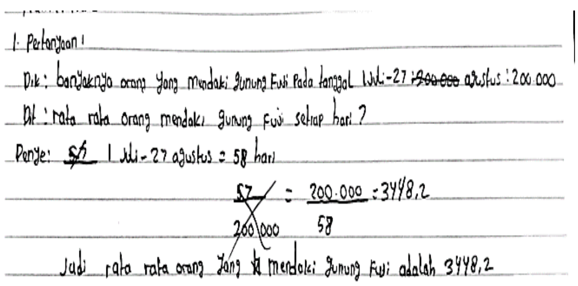

Figure 7. Answer S17 on Mount Fuji Theme Question 1

Based on Figure 7, S17 was able to write down the information contained in the problem and write the known and questionable elements in the problem correctly. S17 was able to estimate the way to solve the problem but was not able to write it completely on the answer sheet. S17 was able to compile the steps of working quite well. Seen on the answer sheet, to find the average person who climbs Mount Fuji every day is to divide “200,000” / “58” “=3448.2” However, S17 did not provide information on the answer sheet for “200,000” / “58” “=3448.2” what was sought. S17 was able to conclude the statement well according to the steps he used. This is supported by the results of the interview as follows:

P : Let's start from the theme of Mount Fuji, question 1.
S17 : Yes, sis.
P : What is known from the question
S17 : It is known that the number of people who climbed Mount Fuji on July 1 - August 27 is 200,000 people.
P : What is being asked?
S17 : What is asked is the average day people climbed Mount Fuji?
P : What do you need to do to solve this problem?
S17 : First, I calculated the number of days from July 1st to August 27th which is 58 days.

P : Where did you get the 58 days from?
S17 : From the number of days in July which is 31 and added 27 days in August.
P : Then, is there another way or not to solve it?
S17 : There is kak, to find the average number of people climbing each year the number of people divided by the number of days earlier.
P : Okay. Now what are the calculation steps you took in solving the problem?
S17 : “200.000“ /”58”
P : So, what you mean by “200,000”/“58” is to calculate the average number of people who climb Mount Fuji?
S17 : Yes, I did but I didn't write it down earlier.
P : Okay. Then how many results did you get
S17 : The result is 3448.2
P : What is the conclusion of the question?
S17 : So, those who climb Mount Fuji every day are 3448 people per day.

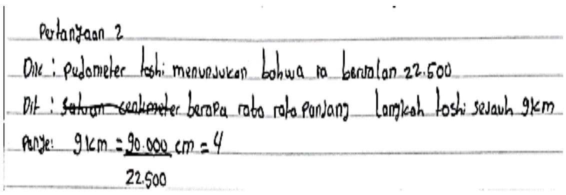

Figure 8. S17's answer to Mount Fuji theme question 1

Based on Figure 8, S17 was able to understand the question of the theme of Mount Fuji question 2. On the answer sheet, S17 was able to write down what information was contained and write the known and questionable elements in the problem correctly in the problem. S17 wrote some of the solution concepts inaccurately so that they were not in accordance with the correct procedure, it can be seen that S17 immediately wrote “9km =” “90,000 cm” / “22,500” S17 should first write how he changed the unit 9km to cm. S17 was able to organize the steps of working well. The steps he used were correct but the results were not correct. S17 was not able to conclude the statement, this is because he concluded the answer by re-reading the answer on the answer sheet. This is supported by the results of the interview as follows

P : Okay now we continue on the theme question of Mount Fuji question 2, what is known in the question?
S17 : It is known that toshi's pedometer shows that he walked 22,500 meters.
P : Next, what is asked in the question?
S17 : What is the average length of toshi's steps for 9km
P : Try to explain now, what method do you use to do this problem?
S17 : First, the unit of 9km must be converted into cm and the result is 90,000 cm. Because the question asked in centimeters, then to find the average length of toshi's footsteps I divided 90,000 cm by 22,500.

P : What calculation steps did you take in solving the problem?
S17 :
P : I calculated 90,000/22,500 and the result was 4 kak.
S17 : What is your conclusion?

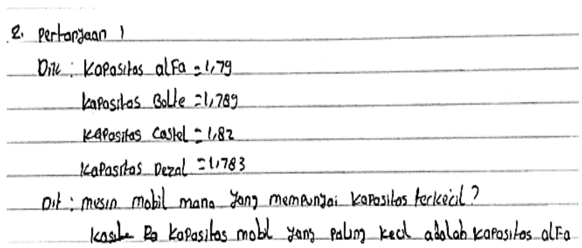

Figure 9. S17's answer to Driver Theme Question 1

Based on Figure 9, S17 was able to understand the question about the theme of Mount Fuji question 2 well. On the answer sheet, S17 was able to rewrite the known elements and write what was asked from the problem correctly. S17 was unable to explain the steps taken to solve the math problem. S17 was unable to organize the steps and did not do the calculations well. S17 was able to write the conclusion but it was not correct. This is supported by the following interview results:

P	:	Next is the driver theme question 1, what is known from the question?
S17	:	It is known that alpha engine capacity is 1.79 bolte capacity is 1.789, castel engine capacity is 2.82 and dezal engine capacity is 1.783.
P	:	Then what is asked
S17	:	Which car engine has the smallest capacity?
P	:	What is needed to solve problem number 3?
S17	:	Eemm ... don't know kak
P	:	But, here you write your conclusion, how do you get that conclusion?
S17	:	Because the question is multiple choice so I just choose kak
P	:	But I said earlier that even though the question is multiple choice, there must still be a solution
S17	:	Yes, but I don't know....
P	:	Then what is the conclusion of this problem
S17	:	So, the capacity of the smallest car is alpha car

To find out the level of mathematical reasoning ability of subject S17, the researcher calculated the score obtained by S17 in solving the PISA question on number content, the following are the results of the calculation of S17's score

$$\text{TKPM}_{\text{S17}} = \frac{\text{score obtained}}{\text{score maksimum}} \times 100\%$$

$$\text{TKPM}_{\text{S17}} = \frac{22}{33} \times 100\%$$

$$\text{TKPM}_{\text{S17}} = 66{,}7\%$$

From the results of the analysis of the scores obtained by subject S17 above, it can be concluded that the level of mathematical reasoning ability of subject S17 is classified as moderate. Based on the data obtained, students with high initial mathematical abilities met the indicator of making conjectures in solving PISA questions on number content across low, medium, and high scales. In solving the given PISA number content questions, these students outlined what was known and asked, both in writing and orally. Regarding the indicator of performing mathematical manipulations, students with high initial mathematical abilities met this indicator only in the PISA questions on number content at low and high scales. This was because they detailed all the necessary formulas or concepts precisely, following the correct procedures in these specific questions.

Students with high initial mathematical abilities met the indicator of constructing evidence, providing reasons or proof for the correctness of solutions in the PISA questions on number content at low and high scales. They were able to use the known elements to answer the questions by following the steps supported by calculations, done systematically and correctly, only in the PISA questions on number content at low and high scales. However, they did not meet this indicator in the medium-scale question because they did not perform calculations on the answer sheet, and after being interviewed, they admitted to not performing the calculations when answering the question. Regarding the indicator of drawing conclusions from a statement, these students only met this indicator in the PISA questions on number content at low and high scales. They failed to meet this indicator in the medium-scale question because they drew conclusions without performing calculations, leading to incorrect conclusions.

Based on the data, students with moderate initial mathematical abilities met the indicator of making conjectures in solving PISA questions on number content across low, medium, and high scales. These students outlined what was known and asked, both in writing and orally, in solving the given PISA number content questions. Regarding the indicator of mathematical manipulation, these students only met this indicator in the PISA questions on number content at the low scale. They wrote down all the necessary formulas or concepts in detail, following the correct procedures in the low-scale questions. However, they did not meet the indicator of performing mathematical manipulations in the medium and high-scale PISA questions on number content because they failed to write down the required formulas or concepts in detail, leading to incorrect procedures and steps in answering these questions. This aligns with the results of the initial mathematical ability test they took, as they could not correctly answer the first question, which involved arranging decimal numbers from smallest to largest—a characteristic shared by the high-scale question.

Students with moderate initial mathematical abilities met the indicator of constructing evidence, providing reasons or proof for the correctness of solutions in the PISA questions on number content at the low scale. However, they did not meet this indicator in the medium and high-scale PISA questions because they did not perform calculations on the answer sheet for the medium-scale question, and after the interview, it was confirmed that they did not perform the necessary calculations when solving the question. These students met the indicator of drawing conclusions from the low-scale PISA question correctly, following the required steps. However, they did not meet the indicator of drawing conclusions from a statement in the medium-scale question because they drew conclusions without performing calculations, leading to incorrect conclusions. They also failed to meet this indicator in the high-scale question because they drew incorrect conclusions based on faulty calculations.

Based on the data obtained, students with low initial mathematical abilities met the indicator of making conjectures in solving PISA questions on number content across low, medium, and high scales. These students outlined what was known and asked, both in writing and orally, in solving the given PISA number content questions. Regarding the indicator of mathematical manipulation, students with low initial mathematical abilities only met this indicator in the PISA questions on number content at the low scale. They wrote down all the necessary formulas or concepts in detail, following the correct procedures only in the low-scale questions.

However, students with low initial mathematical abilities did not meet the indicator of performing mathematical manipulations in the medium and high-scale PISA questions because they failed to write down the required formulas or concepts in detail, leading to incorrect procedures and steps in answering these questions. These students met the indicator of constructing evidence, providing reasons or proof for the correctness of solutions in the low-scale PISA questions, as they could only use the known elements to answer the questions by following the steps supported by calculations, done systematically and correctly, only in the low-scale questions. However, they did not meet this indicator in the medium and high-scale PISA questions because they did not perform calculations on the answer sheet, and after being interviewed, they admitted to not performing the necessary calculations when solving the question.

These students met the indicator of drawing conclusions from the low-scale PISA questions correctly and accurately, following the required steps in the low-scale PISA number content questions. However, they did not meet the indicator of drawing conclusions from a statement in the medium-scale question because they drew conclusions without performing calculations, leading to incorrect conclusions. They also failed to meet this indicator in the high-scale question because they did not write a conclusion for the question.

CONCLUSION

Based on the data analysis, research results, and discussion, the following conclusions can be drawn: (1) Students with high mathematical abilities in solving PISA questions on the number content are categorized as having high mathematical reasoning abilities. They meet the indicators of making conjectures, performing mathematical manipulations, constructing evidence, providing reasons or proof for the correctness of solutions, and drawing conclusions from statements in lower and higher-level questions, but only meet the indicator of making conjectures in medium-level questions. (2) Students with moderate mathematical abilities in solving PISA questions on the number content are categorized as having moderate mathematical reasoning abilities. They meet the indicators of making conjectures, performing mathematical manipulations, constructing evidence, providing reasons or proof for the correctness of solutions, and drawing conclusions from statements in lower-level questions, but only meet the indicator of making conjectures in medium and higher-level questions. (3) Students with low mathematical abilities in solving PISA questions on the number content are categorized as having moderate mathematical reasoning abilities. They meet the indicators of making conjectures, performing mathematical manipulations, constructing evidence, providing reasons or proof for the correctness of solutions, and drawing conclusions from statements in lower-level questions, but only meet the indicator of making conjectures in medium and higher-level questions..

REFERENCES

Alifin, R., Kodirun, & Ikman. (2018). Analisis Kemampuan Penalaran Matematis Siswa Kelas VIII SMP Negeri 5 Kendari Ditinjau Dari Perspektif Gender. *Jurnal Penelitian Pendidikan Matematika*, *6*(1), 155-168.

Anisah, Zulkardi & Darmawijoyo. (2011). Pengembangan Soal Matematika Model PISA Pada Konten Quantity Untuk Mengukur Kemampuan Penalran Matematis Siswa Sekolah Menengah Pertama. *Jurnal Pendidikan Matematika, 5(1)*, 1-15.

Azizah, R. F., Sunardi, S., & Kurniati, D. (2017). Penalaran Matematis dalam Menyelesaikan Soal PISA pada Siswa Usia 15 Tahun di SMA Negeri 1 Jember. *KadikmA*, *8*(1), 97-104.

Azmi, U. (2013). *Profil Kemampuan Penalaran Matematika dalam Menyelesaikan Masalah Matematika Ditinjau dari Kemampuan Matematika Pada Materi Persamaan Garis Lurus Kelas VIII SMP YPM 4 Bohar Sidoarjo*. *Skripsi.* Sidoarjo: UIN Sunan Ampel Surabaya

Dewi, I. M. (2018). *Analisis Kemampuan Penalaran Matematis Siswa Dalam Menyelesaikan Masalah Matematika Materi Aritmatika Sosial Kelas VII Di MTs Negeri 6 Tulungagung*. *Skripsi*. Tulungagung: Institut Agama Islam Negeri Tulungagung.

Inayah, N. (2016). Pengaruh Kemampuan Penalaran Matematis Dan Gaya Kognitif Terhadap Kemampuan Komunikasi Dan Koneksi Pada Materi Statistika Siswa SMA. *Journal of EST*, 2(2), 74-80.

Lestari, K. E., & Yudhanegara, M. R. (2015). *Penelitian Pendidikan Matematika. Bandung*: PT Refika Aditama.

Mualifah, A. N & Lukito, A. (2014). Profil Penalaran Siswa dalam Pemecahan Masalah Open Ended Ditinjau dari Kemampuan Matematika. *Jurnal Ilmiah Pendidikan Matematika,*3(3), 9-16.

OECD. (2014). *PISA 2012 Results: What Students Know and Can Do Student Performance in Mathematics, Reading and Science Volume I.* Retrieved September 23, 2020, from https://www.oecd.org.

OECD. (2019). *PISA 2018 Results*. Retrieved September 23, 2020 from https://www.oecd.org.

Putra, N. (2012). *Metode Penelitian Kualitatif Pendidikan.* Jakarta: PT. RajaGrafindo Persada.

Putri, D. K., Sulianto, J & Azizah, M. (2019). Kemampuan Penalaran Matematis Ditinjau Dari Kemampuan Pemecahan Masalah. *International Journal Of Elementary Education, 3(3),* 351-357.

Rosaliana, D., Muhtadi, D., & Setiawati, T. (2019). Kemampuan Penalaran Matematis Siswa Pada Materi Program Linear. In *Prosiding Seminar Nasonal & Call For Papers.*

Suprihatin, Maya, T. R. P. & Eka, S. (2018). Analisis Kemampuan Penalaran Matematis Siswa SMP Pada Materi Segitiga Dan Segiempat. *Jurnal Kajian Pembelajaran Matematika*, 2(1): 9-13.

Susilowati, J. P. A. (2016). Profil penalaran siswa SMP dalam pemecahan masalah matematika ditinjau dari perbedaan gender. *Jurnal Review Pembelajaran Matematika*, *1*(2), 132-148.

Wardhani, S., & Rumiati. (2011). *Instrumen Instrumen Penilaian Hasil Belajar Matematika SMP: Belajar Dari PISA Dan TIMSS*. Yogyakarta: PPPPTK.

Wijaya, R., Fahinu, & Ruslan. (2018). Pengaruh Kecemasan Matematika Dan Gender Terhadap Kemampuan Penalaran Adaptif Matematika Siswa SMP Negeri 2 Kendari. *Jurnal Penelitian Pendidikan Matematika, 9(2),* 173-184.