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# An Analysis of Student Difficulties in Solving Problems of Reasoning Absolute Value Material

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## *Abstract*

This study aims to determine the types and factors that cause student difficulties in solving reasoning problems on the absolute value material. This research is a type of qualitative descriptive. The subjects of this study were students of class X MIPA 5 SMAN 3 Surakarta in the 2019/2020 school year. Subjects were taken using a purposive sampling technique. The data collection technique used tests and interviews. Before the test is used, it is validated by an expert. Data analysis was carried out using data reduction, data presentation, and concluding. The results of this study indicate that the types of student difficulties are 1)fact difficulties, where the subject has difficulty in analyzing and linking the information from the questions with the questions in the questions. The difficulty of the subject is because the subject does not understand the problem and rarely does the problem in the form of a story; 2) Conceptual difficulty, where the subject has difficulty determining the limits of the two absolute value equations. In determining the limits on the absolute value equation, it is necessary to define absolute value. The difficulty of the subject is because the subject still does not understand the absolute value material; 3) skill difficulty, where the subject has difficulty performing algebraic operations in determining the value of x. The difficulty of the subject is because the subject is not careful in doing and checking the written answers again.

***Keywords:*** *Student's Difficulties; Causative Factor; Mathematical Reasoning*

## *Introduction*

Mathematical reasoning is one of the crucial components that students must have. The reason behind the statement is because; 1) Reasoning is one component of the standard process of the NCTM (NCTM, 2000), 2) contained in the New Jersey (NJMCF) mathematics curriculum framework (Wulandari & Wutsqa, 2019) stated that reasoning ability functions as an adhesive component to combine and strengthen all abilities related to mathematics, 3) is one of the assessments of TIMSS namely on the cognitive dimensions including knowlidge (remembering and recognize fact, procedure, and concept), applying (focus on problem solving), and reasoning (Yaman & Jailani, 2019), and 4) Minister of Education and culture (Kemendikbud) Regulation No. 22 of 2006 about content standard for primary and secondary school stipulates that goals of studying abilities about pattern and quality, carry out general mathematics manipulations, gathering proof or explaining the idea and mathematic statement (Ayuningtyas, Mardiyana, & Pramudya, 2019).

Mathematical reasoning is a part of mathematical thinking which is involve making announcements and for getting valid conclusions about some ideas and how these ideas can be interelated (Widiartana, 2018).Students can optimize their reasoning skills by building arguments within themselves, for example: is that strategy have function or not, is that strategy generally can be applied for other problems, and when that strategy be able to used more efficiently (Ratnasari & Abadi, 2018).

Ario stated in general mathematic, mathematical reasoning divided into two categories, these are inductive reasoning and deductive reasoning. The mean inductive reasoning is reasoning based on a limited number of cases or examples that are observed. Deductive reasoning is the process of reasoning from a knowledge of principles or general experience that leads us to conclusions for a particular (Yusdiana & Hidayat, 2018). Furthermore, Sumarmo and Hendriana (Bernard & Chotimah, 2018) explain inductive reasoning including analogy reasoning, generalization, estimation, or estimating the answer and solution process and constructing the conjecture. Inductive reasoning above can be classified as thinking mathematically low or high level depending on the complexity of the situation involved. While deductive reasoning includes performing arithmetic operations; draw logical conclusions; explain the model, facts, nature, relationships or patterns; propose opposing examples; follow the rules of inference; check the validity of arguments; construct valid arguments; formulate the definition; and construct a direct evidence, indirect evidence with mathematical induction. Thus, mathematical reasoning is the ability to generalize, estimate or estimate answers and process solutions, construct conjectures, construct valid arguments, formulate definitions, and draw direct evidence, and draw logical conclusions.

The fact that Indonesia is still under ASEAN countries, such as Malaysia and Thailand. Indonesia also involvement in the TIMSS program for seeing educational programs of developing countries and compared with other countries. The 2015 TIMSS survey results showed that Indonesia ranked 44th out of 49 countries surveyed with an average acquisition of 394 and an international average score of 600 (TIMSS, 2015). The measurement of TIMSS achievement was getting by student is not much different from the results of the National Examination in Indonesia. One region of Indonesia that need more attention is Surakarta city. The average National Mathematical National Examination (UN) score for high school students in Surakarta last two years is shown in Table 1.

**Table 1. Average National Exam (UN) Score in Mathematics Subjects in the Last Three Years in the city of Surakarta (Kemendikbud, 2019)**

| Average National Examination Score (UN) | | |
|---|---|---|
| Academic Year 2016/2017 | Academic Year 2017/2018 | Academic Year 2018/2019 |
| 59.13 | 55.56 | 54.71 |

**Table 1** show that from year to year, the average national examination of mathematics has decreased. In the 2016/2017 academic year the average score of the national mathematics test was 59.13, In the academic year 2017/2018 the average score of the national mathematics test was 55.56, and in 2018/2019 the average score of the national mathematics test was 54.71.

Meanwhile, research shows the low mathematical reasoning ability of students. Research conducted by (Agustyaningrum,Hanggara, Husna,Abadi,&Mahmudii,2019)shows that the percentage of students' mastery in making guesses only reaches 43.50%,doing 21.75%mathematical manipulation,drawing conclusions, giving valid reasons or proofs for a 40.25% solution, and draw conclusions from the statement 63%.Research by(Hasratuddin, Siregar,& Banjarnahor, 2019) revealed that students' mathematical reasoning ability only reached an average of 40,867 and was in a low category.The results of the research (Fisher, Kusumah, & Dahlan, 019)show that the percentage of mathematical reasoning abilities used in each indicator is only up to the low and medium categories. Indicators present written statements using their own language as much as 31.25% which is classified as low,presenting a written mathematical statement by presenting a mental statement from a graph of

50.00% which is classified as moderate, providing reasons or proof of the truth of 34.37% which is low, estimating the answer and solution process of 9.37% classified as very low. Based on the description above, it is necessary to conduct research that aims to determine the types and factors that cause students to have difficulty solving reasoning problems in SMA Negeri 3 Surakarta.

## *Methodology*

This research is descriptive qualitative research. Descriptive research does not provide treatments, manipulations, or changes to variables, let alone design something that is expected to happen to the variable, but all activities, circumstances, events, aspects, components, or variables run as they should (Haryadi & Nurmaningsih, 2019). subjects in this study were students of class X MIPA 5 SMA Negeri 3 Surakarta in the 2019/2020 school year. Taking the subject is done by purposive sampling.

Data collection techniques carried out were: 1) Tests, tests in this study were in the form of description questions given to all students of class X MIPA 5 SMAN 3 Surakarta to determine the types of student difficulties. The number of students who were given the test was 36 students. Based on the results of student tests, 4 students who have the most errors in each indicator of mathematical reasoning will be taken; 2) Interview, the interview method in this study is used to obtain information about the factors that cause students difficulty in completing questions of reasoning material for absolute value. This research uses a free interview that is guided by the students' answers. Eisenberg (Mutia, 2017) defines an interview as a meeting of two people to exchange information and ideas through questions and answer so that they can construct meaning in a particular topic. 3) Documentation, data obtained from the study of documentation in the form of test results, and interview results.

This research uses data analysis techniques such as data reduction, data display, and conclusion. In this research, the validity is done by the triangulation technique. Technical triangulation is done by asking the same thing with different techniques, namely by interviewing and documenting.

## *Result and Discussion*

After all student answers are corrected, then the answer that has the most errors is selected in each indicator of mathematical reasoning and an interview is conducted to explore more about the types of difficulties and factors that cause students to experience difficulty in solving questions through interviews. As for questions, answers, and results of student interviews as a few.

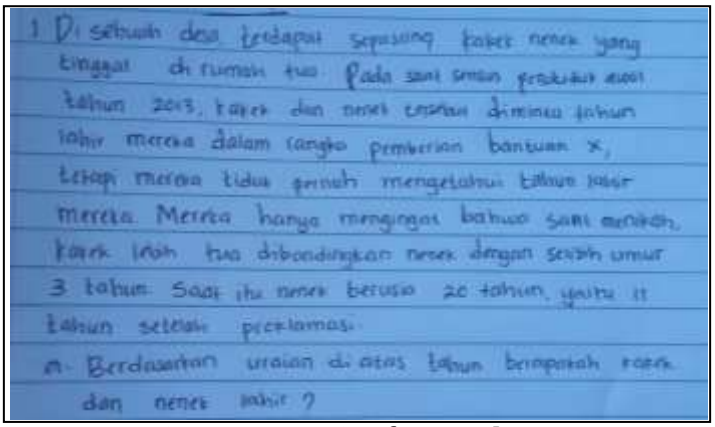
1. Di sebuah desa terdapat sepasang kakek nenek yang tinggal di rumah tua. Pada sani sman prakarsa angkatan tahun 2013, kakek dan nenek tersebut diminta tahun lahir mereka dalam rangka pemberian bantuan x, tetapi mereka tidak pernah mengetahui tahun lahir mereka. Mereka hanya mengingat bahwa sani mereka, kakek lebih tua dibandingkan nenek dengan selisih umur 3 tahun. Saat itu nenek berusia 20 tahun, yaitu 11 tahun setelah proklamasi.
a. Berdasarkan uraian di atas tahun berapakah kakek dan nenek lahir ?

**Figure 1. Question for Number 1a**

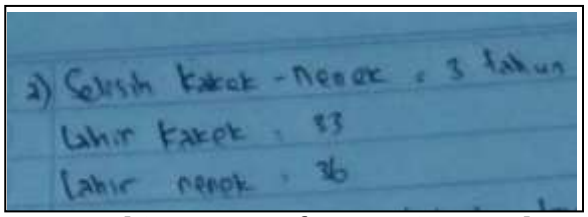


**Figure 2. Subject Answer for Question Number 1a**

The results of the researcher interview (P) with subject 1 (S1) are as follows:

P :Now consider answer number 1a, in answering the question, are there any obstacles encountered?
S1 : No sir
P :Try to explain how to produce grandparents born 33 years and grandmothers 36 years of birth?
S1 : Isn't that just a matter of leaving, sir?
P : Try to explain
S1 : They got married in 1956. It means that grandma is 20 years old because the difference in their birth is 3 years, then my grandfather is 23 years old. Therefore, my grandmother was born in 1956 - 20 = 1936, the year my grandfather was born 1956-23 = 1933. Is it like that, sir?
P : Now consider your answer, is it what you asked for the problem?
S1 : Eeeh ... Yes sir
P : Naaah ... then why is the answer like that?
S1 : I wrote it wrong, sir

Based on the answers and the results of the interview it was found that the subject was actually able to answer correctly, but the subject in answering was not in detail and the answer was not according to what was in his mind. Seen from the answers to the subject and the results of the interview are different. Judging from the answers, the subject only lists the difference in the age of both grandparents and immediately writes the age of grandfather is 33 and the age of grandmother is 36. While in the interview results, the subject explains in detail and correctly. Obtained conclusions that the subject did not find it difficult to answer the problem but the subject simply did not focus on writing answers that resulted in incorrect subject answers, other than that the subject did not write the answers in full.

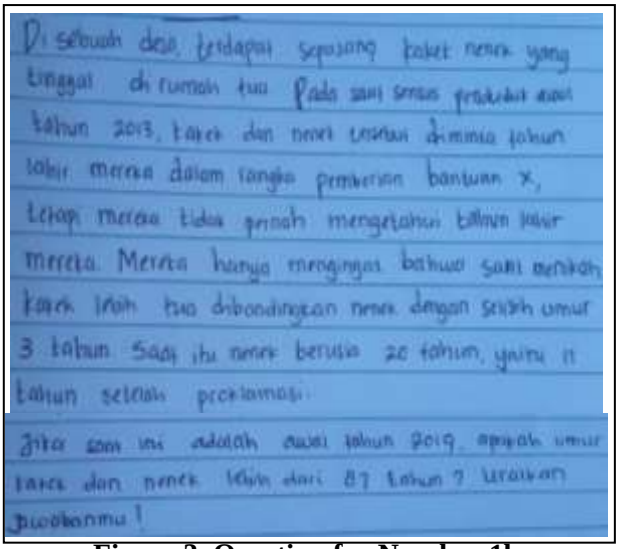


**Figure 3. Question for Number 1b**

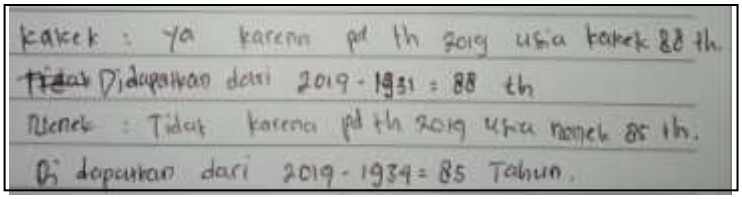


**Figure 4. Subject Answer for Question Number 1b**

The results of the researchers' interview (P) with the subject (S2) are as follows:

P :Please pay attention to sister's answer number 1b, are there any obstacles in answering?
S2 :No sir.
P :If I pay attention to my younger siblings' answers, my younger siblings answer that my grandfather's age is more than 87 years, and grandma's age is not more than 87 years.
S2 Grandfather is more than 87 years old, while the grandmother is less than 87 years old.
P : Do you think 85 years old is correct?
S2 : Yes, that's correct, sir
P : Try to explain how getting 1931 was the year grandfather was born?
S2 : First I looked for grandma's age. Grandma's age is 1934. Then the difference between the age of grandmother and grandfather is 3 years older than grandma, therefore grandfather was born in 1931. Like that sir
P : Then try to explain why 1934 was the year your grandmother was born!
S2 : I obtained 1934 by way of 1945 reduced by 11. Because my grandmother was 20 years after the proclamation.
P : Why did you reduce 1945 by 11?
S2 : I think the formula is like that
P : From here we know the location of the sister's fault, namely the sister's fault in finding grandfather's birth year.
S2 : So your answer is wrong? What's the right year, sir?
P : The truth is 1933
S2 : How do you do that, sir?
P : Grandmother's age after 11 years of proclamation is 20 years because their age difference is 3 years, then my grandfather's age is 23 years. Grandfather's birth year = (1945 + 11-23) = 1933. Now, why 1945 -11?
S2 : I can't relate what is known to what is asked by the question, I can't analyze the questions, sir.
P : Do you often work on story problems?
S2 : Rarely sir

Based on the answers and the results of interviews with the subjects, it was found that the subject had difficulty in analyzing and linking information to the questions to the questions asked. The subject was wrong in answering the problem because the subject rarely worked on problems that came into the story.

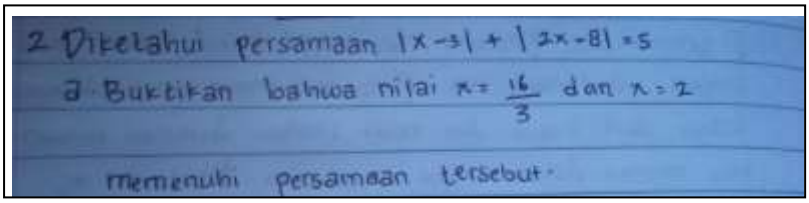


**Figure 5. Question for Number 2a**

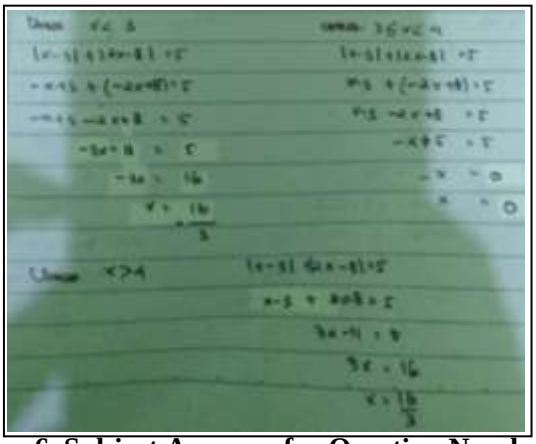

**Figure 6. Subject Answare for Question Number 2a**

The results of the researcher interview (P) with the subject (S3) are as follows:

P : Now consider sister's answer number 2a
S3 : Yes sir
P : Are there any obstacles you faced when answering this question?
S3 : In determining the boundaries, I doubt it, sir. I doubt the lines I made. If the number line is wrong then my final answer is wrong.
P : For the limits are correct. Try to pay attention to the limit x <3, is the x value correct like that?
S3 : No sir
P : Where is the error?
S3 : I have rechecked my work, but I am confused, sir
P : Why are you confused, where is the confusion?
S3 The sign + (positive), - (negative) is correct, then I calculate the answer again the same
P : Now consider lines 2 and 3, what is odd about one of these lines?
S3 : Oh yeah, it should be 8 + 3 positive 11
P : Now has the fault been located?
S3 : Yes ... the result should be x = 2
P : Yeah right, why did you write -11
S3 : I am not careful, sir
P : o ... where does the value of x satisfy the equation?
S3 : Those who meet the requirements are x <3 and x> 4

Based on the answers and the results of the interview, it was found that the subject had difficulty in determining the limits of the two absolute value equations and still had difficulty in operating algebraic counts. This is because the subject does not understand the material absolute value. Besides, the subject is still unable to detect the location of the mistakes made. The subject has rechecked the answer but still cannot find the location of the error. The subject's answers also stop at determining the value of x without having to make a statement that the value of x is both proven and some not.

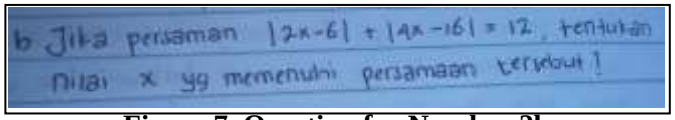


**Figure 7. Question for Number 2b**

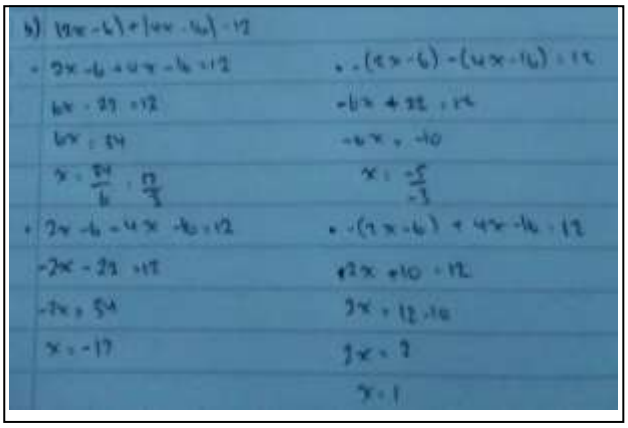

**Figure 8. Subject Answare for Question Number 2b**

The results of the researchers' interview (P) with the subject (S4) are as follows:

P : Try to consider answer 2b, are there any obstacles in answering this problem?
S4 : A little
P : Where is the obstacle that your sister experiences
S4 : I forgot how to do it a little
P Absolute value material must use a definition to find its limits, why not look for boundaries first?
S4 : I'm confused, sir
P : Try to explain why you can write 2x-6-4x-16 = 12!
S4 : I replaced the + (positive) sign in the middle to the - (negative) sign
P : Why is it replaced?
S4 : I Don't know sir, I answered carelessly sir
P : From your answer, which value of x satisfies the equation?
S4 : I Don't know Sir

Based on the answers and the results of interviews with students it was found that the subject had difficulty in determining the limits on the two absolute value equations, besides that, the subject also had difficulty in determining the steps to find the value of x. This is because the subject does not understand the concept of the definition of absolute value and does not understand the material, this can be seen from the subject's answer that the subject does not make restrictions on the equation and the subject only performs operations by replacing the + sign, - on the equation. From the results of the interview also the subject was confused by what he was doing. The subject is just doing without considering the right or wrong results obtained. Besides students do not answer according to the desired problem, the subject is only looking for grades without clarifying the value of x that meets.

## *Conclusion*

Based on the description of the results of the research and discussion, it was found that the types of difficulties experienced by students and the causative factors were 1) factual difficulties, where the subject had difficulty analyzing and linking the information from the questions with the questions in the questions. The difficulty of the subject is because the subject does not understand the problem and rarely does the question in the form of a story; 2) Difficulty of concepts, where subjects have difficulty in determining the limits on two absolute value equations. In determining the limits on the absolute value equation, the definition of absolute value is needed. The difficulty of the subject is caused because the subject still does not understand the material absolute value; 3) skill difficulties, where subjects have

difficulty doing algebraic operations in determining the value of x. The difficulty of the subject is caused by the subject being not careful in working on and rechecking the written answers.

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