Reasoning of Elementary School Students in Higher Order Thinking Skills (HOTS) on Fraction basic on Adversity Quotient

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Abstract
The aims of this study is to describe students' reasoning in solving higher order thinking skills (HOTS) problems in fraction material reviewed based on adversity quotient. The subjects are three students namely one student with quitter type, camper and climber. The instruments used included the Adversity Response profile (ARP), HOTS tests and interview guidelines. The process of data collection is done by giving tests and interviews to get more in-depth information. The results showed students' reasoning ability with the type of quitter had not achieved basic level thinking skills, reasoning students with the camper type were in critical thinking and the reasoning of students with the climber type was on the ability to think creatively.
Keywords: *Reasoning, HOTS Problem, Fractions, Adversity Quotient.*

I. Introduction

One of the subjects that has an important role in developing student reasoning is mathematics. In accordance with Permendikbud Number 59 of 2014, the goal of mathematics lessons given to students since elementary school is to equip students with the ability to think logically, analytically, systematically, critically, innovatively and creatively, as well as the ability to work together. (Permendikbud, 2014). All of these thinking skills are very useful for students in processing the information obtained, evaluating the information so that they are able to determine new solutions in solving a problem.

Based on the learning objectives above, it can be said that mathematics and reasoning are like two sides of a coin that cannot be separated. Both show a very strong relationship where reasoning becomes important in mathematics. Corner (2014) explains that *"It has long been accepted by a reasoning important in mathematics both in learning mathematics and in doing*.

The same opinion was also expressed by Russell (1999) that *"reasoning is fundamental to understanding mathematics and mathematical reasoning should be promoted by engaging students in investigating, representing, conjecturing, explaining and justifying mathematics*. Shadiq (2007) states that through reasoning abilities students can show and analyze every problem that appears clearly, can assess something critically and objectively, can fuse opinions and ideas in a coherent and logical way, be able to draw conclusions and decisions correctly and be able to solve problems appropriately. The *National Council of Teachers of Mathematics* (NCTM) explains that there are 5 standard mathematical learning processes that students must have namely problem solving, reasoning and proof (*reasoning and proof*), communication (*communication*), connection (*connection*) and representation (*representation*) (NCTM, 2000, p.164). Reasoning in mathematics can help students use reasoned skills in making predictions on the basis of their experience so that they gain an understanding of mathematical concepts and are able to apply them so that learning becomes meaningful (*meaningful learning*). English (2004) states that *"The traditional view of computational and analytical mathematical reasoning as superior has been revised to accommodate processes that are important in today's knowledge based. These include gathering evidence, analyxing data, making conjectures, constructing documents, drawing and validating logical conclusions and proving assertions "*

According to Klurik & Rudnick (1995) reasoning includes basic thinking, critical thinking and creative thinking. Basic thinking is the ability of students to understand the concepts in mathematics correctly. Students are said to understand mathematical concepts when they are able to express or explain concepts using their own words and not just memorize. In addition, he can also find and explain the relationship between one concept and other concepts in solving a problem. Critical thinking is thinking that involves testing, connecting and evaluating all aspects of a problem or situation. Critical thinking is characterized by students' ability to collect, organize, remember, and analyze information to determine conclusions. Creative thinking is original and reflective thinking and produces a complex product. According to Krulik and Rudnick

in creative thinking students can synthesize ideas, build ideas, plan ideas and apply these ideas so that they discover and produce new products.

There are several problems related to students' reasoning in mathematics. Gunham (2014) in his study concluded that students' reasoning abilities were still low in providing explanations and evidence of a problem solving conclusion obtained. Lenola, et al. (2016) further revealed that students' reasoning abilities in solving problems were in the low category of 4%, students with medium category reasoning abilities as much as 32%, and students with high category reasoning abilities as much as 64%.

Another problem regarding the students' low reasoning abilities was expressed by Aboselem (2016), in his research he concluded that test questions designed by the teacher only measured low order thinking skills in Bloom's taxonomy, namely at the remembering level of 28.57% , understand 14.29% and apply 57.14%. while for high-ability questions, at the level of analysis, evaluation and creation are 0%.

One of the basic material in mathematics that must be mastered by elementary school students is fraction material. Good ability in fractions will help students understand other mathematical materials. As Kim (2015) said that *fraction was specifically selected as the focus of the problem because it is embedded in the content of elementary and intermediate algebra*. The reason for studying fractions is fractions are considered as the basic material for lecturing other mathematical concepts such as algebraic material and also for higher concepts.

In overcoming the problem of low student reasoning in Indonesia, the government introduced the issue of HOTS (*Higher Order Thinking Skills*). In the 2013 Curriculum HOTS type questions began to be developed with the aim of students not only being able to solve routine questions using standard formulas / algorithms, but also must be able to reason and use mathematics to solve non-routine problems encountered in daily life - day.

Minister of Education and Culture (2017) revealed that HOTS is a question that requires high-level thinking skills and involves a reasoning process, so that it can hone critical thinking skills, logical, reflective, metacognitive, and creative. The HOTS problem develops students' ability to think at the level of analysis, evaluation, and creation. (Anderson & Bloom, 2001).

HOTS questions have a big role for students, among others 1). Equip students to have skills in saving the 21st century, 2). increase student learning motivation, 3). improve the quality of questions 4). increasing love for the progress of the region. In working on the *HOTS* Question, students are expected to be able to apply the knowledge and methods that have been learned in solving a problem in a creative, innovative way to the stage of discovering an innovation / new discovery. (Minister of Education and Culture, 2018). Furthermore, Arifin (2018) explains that through *HOTS* questions students can criticize and evaluate information, make conclusions and make generalizations. Students can also create various solutions to solve problems related to everyday life.

Students 'ability to solve Higher Order Thinking Skills problems is influenced by students' resilience in facing challenges or problems. Students' responses in facing a challenge vary. Someone can solve the problem well if supported by the ability to solve good problems too. The ability that is in someone in facing a challenge or problem and looking for a solution to the problem is known as *Adversity Quotient* (AQ). According to Stoltz (2000), *Adversity Quotient* is the ability of students to survive and overcome problems. This ability includes perseverance, patience, steadfastness and is not easily discouraged in facing problems.

Stolzt (2000) revealed that *Adversity Quotient* (AQ) has four dimensions namely *Control, Original, Ownership, Reach and Endurance*. These dimensions include how a person responds to a problem. By using these four dimensions, we can see the response categories of each person in the face of difficulties. Stolzt classifies people based on their level of intelligence *Adversity Quotient* (AQ) into three groups namely *Quitter, Champer and Climber.*

Based on the background described above, the researcher wants to conduct research with the aims **"Reasoning of Elementary School *Higher Order Thinking Skill* (HOTS) on fraction on based on *Adversity Quotient* (AQ)".**

II. Methods

This research is a type of qualitative research with descriptive research methods. Student reasoning will be identified and described based on the HOTS Test results and the results of the interview based on reasoning tests. This research was conducted at SD GMIT Soe II. The subjects in this study were 5th grade students of SD GMIT Soe II. The technique in selecting subjects starts with selecting the class of prospective research subjects, followed by giving the Adversity response profile (ARP) test for grouping students in 3 types namely quitter type students, campers and climber. From the results of grouping based on ARP, the research subjects were selected consisting of one type of quitter student, camper and climber. The instruments in this study consist of two types, namely the main instrument and supporting instruments. The researcher will also observe and monitor directly the implementation of the *Higher Order Thinking Skills Test* and Questionnaire on the *Adversity Response Profile* (ARP) and interview activities with the research subjects. Supporting instruments include the *Higher Order Thinking Skills* (HOTS) Test, *Adversity Response Profile* (ARP), interview guidelines and recording devices. All supporting instruments make and the second validation process is carried out.

The interview used in this study was a semi-structured interview. This is done to get more in-depth information about students' reasoning in working on the *HOTS* Test. The data analysis technique consists of the stages of reducing data, presenting data and conclusions. The following is the Student Reasoning Indicator in solving HOTS problem :

Reasoning	Student activity	Code

Basic thinking	➢ Explain the information available on the question ➢ Explain the mathematical concepts that will be used in solving problems	➢ BC1 ➢ BC2
Critical Thinking	➢ Check and determine information that does not yet exist and use all information in solving a problem ➢ Determine the conclusion of a problem ➢ Arguing against problem solving	➢ CL1 ➢ CL2 ➢ CL3
Creative Thinking	➢ Plan new ideas or solutions in solving problems ➢ Applying new ideas or solutions that are different from solving previous problems	➢ CV1 ➢ CV2

III. Research Finding

a. Based on the results of the HOTS test and reasoning based interviews, it was shown that the three subjects had different reasoning abilities. *Question number one*: In commemorating the "National Awakening Day" on May 20, 2019 all delegates IV to V SD GMIT SOE II were sent to attend the ceremony at the SOE Puspenmas Field. The total number of students participating in the program is 80 people. During the ceremony there were differences in costumes used by students. There are $\frac{3}{4}$ students wearing red and white clothes, $\frac{1}{5}$ students wearing pramuka clothes, and the rest students wearing sports clothes. Determine the number of students who wear red and white clothes and sports clothes!

Then the written test results and interviews with camper type students (SCP) in completing question number 1.
P: From the matter of what you read related to what material?
SCP: fraction (BC1)
P: Why do you say it's fraction material?
SCP: Because there are characteristics of fractions (BC1)
P: what are the characteristics of fractions?
SCB: there is a numerator and denominator (BC1)
P :Look at the question, what is known from the problem?

SCP: total number of students 90, $\frac{3}{4}$ using red and white clothing $\frac{1}{5}$ uses pramuka clothes (BC2)

P: what was asked about the question?
SCP : the number of all students using red and white cloth and sports (BC2)
P: mention it information that is not yet available in the question?
SCP: many students use sports clothing (BC2)
P:how to find out many students who wear sports clothes?
SCP:

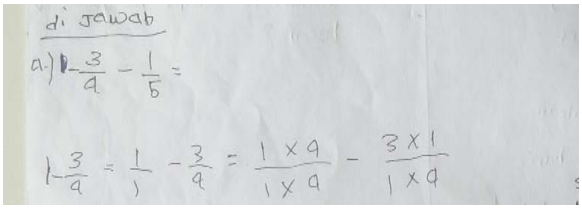

Figure 1a

P : How do you determine results $1-\frac{3}{4}-\frac{1}{5}$?

SCP: The firt step is to determine $1-\frac{3}{4}$ then subtract with $\frac{1}{5}$ (BC2)
P: How do you change 1 into a fraction?
SCP: The fraction of 1 is $\frac{1}{1}$ so it is written $\frac{1}{1}-\frac{3}{4}$ (CL1)
P: how to equate the denominator of two fractions?
SCP : By cross-multiplying the numerator in the first fraction is multiplied by the denominator of the second fraction and the numerator in the second fraction is multiplied by the denominator of the first fraction. As well as for the denominator, the denominator of the two fractions is multiplied as in figure 1a (BC2)
P: What is the result of the reduction?
SCP: then proceed with the reduction of the third fraction to get the results $\frac{1}{20}$ (see figure 1b)

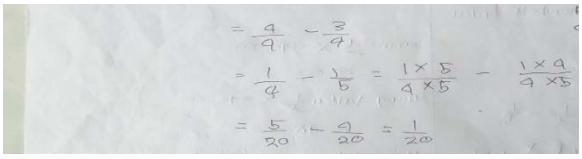

Figure 1b

P: How to determine the number of students using red and white clothes?
SCP: the way is to multiply many parts of students using red and white clothes with the total number of students (see figure 4) (BC2)
P: How to determine the number of students using sports clothing?
SCB: the way is to multiply many parts of students using sportswear with the total number of students (see figure 2) (CL1)

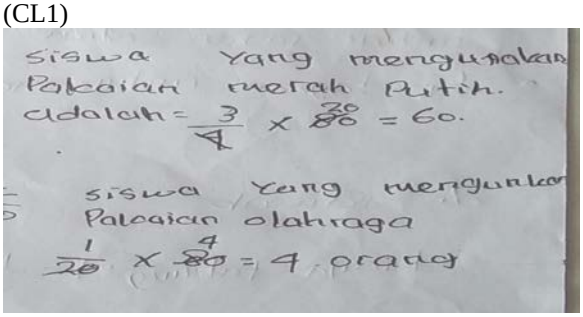

Figure 2

P: What is your conclusion?

SCP: In conclusion, there are 64 students who use red and white clothes and sports. (see figure 3)(CL2)

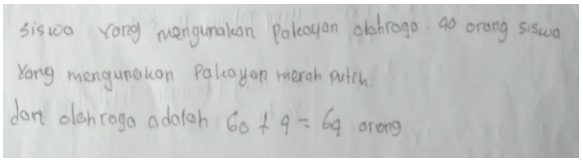

Figure 3

Based on the results of the tests written in figure 3-5 and interviews with camper type students, it was shown that students with the camper type were able to determine information that had not been provided for the existing problems, were able to do the calculation results using a reduction operation, division and multiplication of fractions with steps- step correct solution. He is able to determine the correct conclusion of the problem given and provide a logical argument. So students with camper types are able to reason well and are in the category of critical thinking. He has been able to examine the information that exists and use it in determining how to solve a problem, is able to determine the conclusions of a problem and provide an argument against solving the problem.

Camper and climber type students already have good understanding of the fractions and operations. The difference is that climber students have two different ways of determining the resolution of problem number 1. The following are the results of written tests and interviews with climber type students.

P: From the matter of what you read related to what material?
SCP: fraction (BC1)
P: Why do you say it's fraction material?
SCP: Because there are characteristics of fractions (BC1)
P: what are the characteristics of fractions?
SCB: there is a numerator and denominator (BC1)
P :Look at the question, what is known from the problem?

SCP: total number of students 90, $\frac{3}{4}$ using red and white clothing $\frac{1}{5}$ uses pramuka clothes (BC2)

P: what was asked about the question?
SCP : the number of all students using red and white cloth and sports
SCP : the number of all students using red and white cloth and sports (BC2)
P : mention it information that is not yet available in the question?
SCP : many students use sports clothing (BC2)
P :how to find out many students who wear sports clothes?
SCP :Can be seen in figure 4

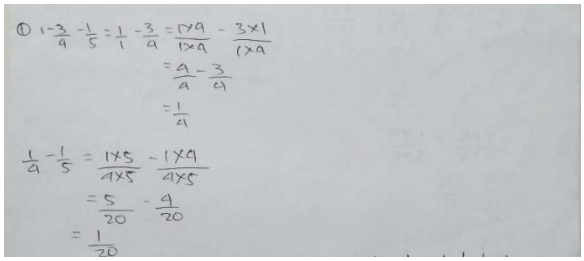

Figure 4

- While the difference with camper type studient lies in the process of finding the number of students using red and white clothes and sports. Camper students only use one method while climber students use two ways
  P: how do you determine the number of students using red and white clothes and sports?
  SCB: the first way: students who wear red and white clothes $\frac{3}{4}$ part are added to students who wear sports clothes $\frac{1}{20}$ part (see figure 5a & 5b)

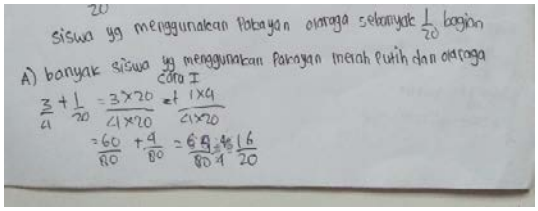

Figure 5a

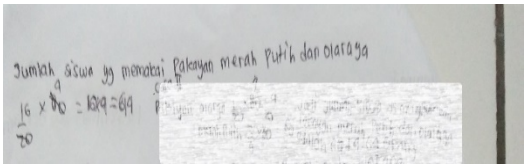

Figure5b

So the number of students who use red and white clothes and sports is that $\frac{16}{20}x80 = 16x4 = 64$ students

P: Do you have other ways to solve problem number 1?

SCB: Yes. Second method: students count each number of students using red and white clothing and sportswear. The number of students who use red and white clothing is that $\frac{3}{4}x$

total of students= $\frac{3}{4} x 80 = 3x20 = 60$ and students who wear sports clothing = $\frac{1}{20} x80 = 1x4 = 4$ (CV1)

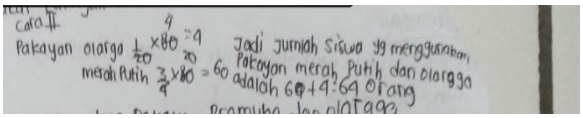

Figure6

So the number of students using red and white clothing and sports is 64 people. (see figure 6)

P: whether the results obtained in the first way are the same in the second way

SCB: the results obtained in the first and second work methods are the same, namely the number of students using red and white clothes and sports are 64 people.

According to the results of written tests and interview transcript for climber type students, this type is able to recognize and understand the fraction concepts used to solve HOTS problems. In connection with the fraction material the climber type students are able to perform subtraction, multiplication, fraction addition operations with different denominators and operations with integers. He uses information that is on all problems, all mathematical concepts that arise and are able to connect with one another. In addition, the climber type is also able to plan new ideas or solutions in solving problems, able to apply new ideas or solutions that are different from the previous problem solving.
Following is the transcript of the interview conducted by quitter type students (SQT) in question number 1.

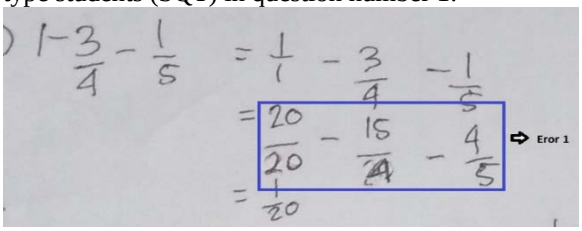

Figure 7

P: Pay attention to the shape 1-$\frac{3}{4} - \frac{1}{5}$, how to determine the result of the reduction in rupture?
SQT: By equating the denominator
P: How do you equate the denominator?
SQT: By multiplying 4 and 5, namely 20
P: What is the next step?
S: numerator First fraction: 20 divided by 20 times 1 result 20
Second fraction numerator: 20 for 4 times 5 results 15
3: 20 fraction numerator divided by 5 times 1 result 4
P: Okay, but why the value of the second and third fractions is still 4 and 5
SQT: Because the one who changes the denominator is only the first denominator (Error 1)
P: After writing the denominator in the first fraction, what should be done?
SQT: Subtract the numerator so that it gets 1/20

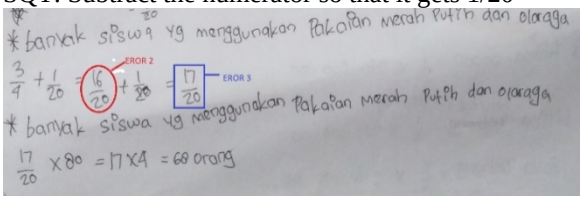

Figure 8

P: Look at the shape again $\frac{3}{4} + \frac{1}{20}$, how to add fractions with different denominators?
SQT: By equating denominators of 4 and 20, namely 20
P: How do you get 20?
SQT: Because there is a denominator of 20 in the second fraction
P: how do you get value $\frac{16}{20}$?
SQT: 20 divided by 4 multiplied by 3 = 5 x 3 = 16, so the results are fractions $\frac{16}{20}$ *(eror 2)*
P: Is 5 x 3 = 16? (error 2)
SQL: Yes Ma'am
P: how do you get value $\frac{1}{20}$?
SQT: 20 divided by 20 times 1, so the fraction results $\frac{1}{20}$
P: Next what do you do to get the addition?
SQT: add up the numerator so that you get the results $\frac{17}{20}$ (eror 3)
In Figure 7 shows that students experience difficulty in operating a form of subtraction from different denominators. This is because students think that the denominator is only in numbers that have no denominator (error 1). Then in figure 8 students experience errors in connecting the concepts of fraction division and multiplication so that the results are wrong (error 2) and also students make mistakes in doing fraction addition because the results of the multiplication obtained previously are worth the error (error 3).

In solving HOTS questions, quitter type students have not been able to understand the basic concepts in fraction material. Quitter students tend to have errors in associating fraction concepts used in solving a problem. Both errors are found to consist of errors in the process of equating the denominator of fractions with different denominators, doing land in fraction multiplication and addition operations. So the results of student

work and interviews show that the type of quitter cannot provide a good reasoning process in solving HOTS problems. This type has not achieved basic thinking skills because it has not been able to understand the basic concepts in mathematics and connects every concepts and ideas to solve HOTS problems.

Thus it can be said that the reasoning abilities of climber type students are better than quitter and camper types. Climber type reasoning abilities can be classified into the ability to think creatively because he is able to plan new ideas and is able to apply these ideas to find solutions that are different from previous solutions. While the reasoning of students with the camper type is on critical thinking skills and students with quitter types have not achieved basic thinking skills.

IV. Conclusion

Based on the results of research and discussion that has been described that students' reasoning abilities in solving HOTS problems have differences. The reasoning ability of students with the quitter type has not achieved basic thinking skills, reasoning students with the camper type are in critical thinking skills and students with the climber type are in creative abilities.

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