International Journal of Trends in Mathematics Education Research
Vol. 6, No. 3 (2023), pp. 213-219
ISSN 2621-8488 (online)
DOI: https://doi.org/10.33122/ijtmer.v6i3.276

SAINTIS publishing

Research Article

Analysis of difficulties in solving high-level thinking ability questions for middle school students

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Received: 28 August 2023 *Revised: 15 September 2023* *Accepted: 22 September 2023* *Available online: 30 September 2023*

ABSTRACT

This study aims to determine students' higher order thinking skills (HOTS) and to analyze the difficulties experienced by students in solving HOTS questions at SMP Negeri 10 Lhokseumawe. The study used was descriptive qualitative research which was carried out by class VIII students of SMP Negeri 10 Lhokseumawe. The collection of data used is a test in the form of descriptions with material forms and algebraic operations and interviews. The data analysis technique used follows the Miles and Huberman model with data reduction, data presentation and drawing conclusions. The results showed that the students' high-level thinking skills were still in the low category. This can be seen from the success of each aspect of students' higher order thinking skills, namely the ability to analyze by 70.83%, the ability to evaluate by 12.50% and the ability to create or be creative by 33.33%. The results of the interviews found that students were not familiar with questions in the form of application of concepts or problem-solving, and there were still many students who did not have reinforcement of material concept abilities.

Keywords: Higher Order Thinking Ability; Difficulty Analysis; Junior High School Students

1. INTRODUCTION

Nowadays, mathematics is very much needed in the field of science and technology, so the development of science and technology is very dependent on progress in the field of mathematics. According to (Sundayana, 2018) Mathematics is a subject area that contributes to the growth and development of science and technology, so that mathematics can be used as an important medium in training or improving intellectual abilities and skills. Mathematics can train students to think critically, logically and rationally so that it can be used in solving everyday problems and in other areas of study.

In essence, progress in science and technology is based on progress in the field of mathematics and in social life. Learning mathematics means learning about all dimensions of life. According to (Hudojo, 2003)Mathematics is a medium for developing human thinking, which is very much needed in life. Therefore, mathematics is very necessary in solving problems in social life and also in the development of technology and other fields of knowledge. Mathematics is a science that is developing very rapidly, both in terms of material and its uses. Mathematics is one of the fields of study taught in primary education and secondary education which has its own teaching. To be able to survive in the ever-growing world of science and technology, individuals are needed who have high intellectual abilities and skills so that they are able to apply logical, systematic, creative and critical thinking skills in communicating ideas or thoughts in solving a problem.

Nowadays, the use of mathematics in technology is very rapid, so it requires skills that are not only conceptual but more than that, namely high-level thinking abilities, High Order Thinking (HOTS). This ability in learning mathematics is very important, this is because it can influence students' way of thinking in describing materials or problems analytically and being able to relate one material to other material or events that occur. HOTS can also train students to utilize one concept to another, analyze and apply the information obtained, relate the information that has been collected and examine it logically and critically. Newmann stated that HOTS makes students understand concepts better, with HOTS students can differentiate ideas clearly, provide arguments well, be able to solve problems, be able to construct explanations, be able to hypothesize, and understand complex things more clearly (Jailani et al., 2018).

According to (Khoiri, 2014) HOTS problems include the ability to think logically, systematically, reasoning, connection, communication, creative, problem-solving and critical. This ability is closely related to the thinking process. The thinking

process itself is the brain's performance in connecting or linking events both seen and read and can be communicated in the form of problem-solving, ideas, decisions or conclusions. According to Suryadi in(Irawati, 2018)The thinking process is related to what happens in the human brain, related to facts or events that occur in the world, thinking can also be applied in life and thinking can be observed and conveyed to other people or written down. According to (Conklin, 2011), higher order thinking activities play a role in students maintaining their reasons for choosing answers. Students draw conclusions, support the conclusions with evidence, or determine them with concepts that will be applied to solve the problem. Providing or training high-level thinking skills to students is useful so that students have the ability to understand complex problems and can communicate these problems in mathematical models, are able to create hypotheses and test them and can make decisions or conclusions. According to Bloom's Taxonomy, the revised cognitive domain(Lorin W. Anderson, 2001)namely: The first three levels are lower order thinking skills, namely: remembering (C1), understanding (C2), applying (C3), while the next three levels are higher order thinking skills (Higher Order Thinking Skills), namely analyzing (C4), evaluating (C5), and creating (C6).

The facts showed that high-level thinking abilities are still in the low category in written test results. Research conducted by(Mariani et al., 2021)on State Middle School students in East Banjarmasin subdistrict class IX showed that the average high level thinking ability of students was in the sufficient category (scores 41-60). The indicators used in the high-level thinking ability test are analyzing, evaluating and creating. Of these three categories, a very small percentage lies in the creating category, only 20.23%. Other research conducted by(Purbaningrum, 2017)on students at SMP Negeri 18 Palembang class IX showed that students' high level thinking abilities in terms of all learning styles, including visual, auditory and kinesthetic learning styles, were all classified as poor, namely the average score was 21-40. The average value obtained for the visual style was 36.11, for the auditory learning style, 31.82 and the kinesthetic learning style had an average value of 32.8. Study(Irawati, 2018)In class VII middle school students, it shows that students' high-level thinking abilities in solving problem-solving problems are still low, namely the average analytical ability reaches 30%, evaluation ability reaches 32% and creative ability reaches 23%. The results of interviews with several teachers showed that teachers did not carry out enrichment activities for students. Teachers more often provide students with conceptual understanding and questions in the form of symbols, as well as several questions regarding problem-solving (story questions). So students are not used to test questions that maximize brain performance, one of which is students' ability to think at a high level.

In this research, the HOTS questions used as test assessments are questions that have indicators of analyzing, evaluating and creating. In the analysis process, students must first be able to understand the problem and then communicate various ideas in mathematical language. This means that students must have good mathematical communication skills in order to complete the analysis stage of the problem to be answered. According to(Kamila, et al. 2020)In indicator analysis, students are required to be able to specify aspects, describe, organize, compare and find implied meanings in the questions. Evaluating indicators requires students to formulate hypotheses, predict, assess, test, justify or blame. Meanwhile, the creating indicator requires students to be able to design, build, plan, produce, discover, renew, perfect, strengthen, beautify, and change. HOTS questions don't always have to be difficult questions, the most important thing is that these questions have 3 important indicators, namely the student's ability to analyze, evaluate and create.

2. RESEARCH METHOD

This research approach uses a qualitative research approach with a descriptive type. Qualitative research is research that focuses on understanding the circumstances or events experienced by research subjects, for example behavior, perceptions and motivation. The aim of qualitative research is to describe in scientific language, in a special natural context and by utilizing various natural methods (Moleong, 2007). The target research location was SMP N 10 Lhokseumawe located on Jln. Meuraksa, Teungoh Village, Blang Mangat District, Lhokseumawe City, Aceh Province. Research subjects are sources of information and information that are used as research data. Research subjects are target populations who have certain characteristics that the researcher determines to study and then draw conclusions (Sugiono, 2007) i. The subjects of this research were taken from class VIII students of SMP N 10 Lhokseumawe, totaling 25 students. The research subject selection procedure was carried out in three steps. Steps include asking class VIII students at SMP N 10 Lhokseumawe to solve algebra problems. Then the researcher corrected the students' answers. After that, select students to be interviewed based on the results of the students' answers.

The instruments for this research are tests and interviews. According to Suharsimi Arikunto, "A test is a tool or procedure used to find out or measure something in an atmosphere, using predetermined methods and rules." The test that researchers mean in this research is a test of high-level thinking abilities. A test is a set of questions that require answers, or a set of questions that must be responded to with the aim of measuring the ability of the person being asked the questions. A test is also a tool or procedure used to find out or measure something using predetermined methods and rules (Arikunto,

2013). It can be concluded that tests are a tool used to collect information in order to find out, assess and measure student learning outcomes. The test given is in the form of questions containing exponentiation materials in algebraic form. There are three test questions given to students, the first question contains indicators of analyzing and creating, the second question contains indicators of evaluating and creating, while the third question contains indicators of evaluating. and create. The purpose of the test in this research is to determine students' high-level thinking abilities in Algebra material. The subjects taken were 25 class VIII students at SMP N 10 Lhokseumawe. Based on student test results, high, medium and low scores were obtained. In accordance with **Table 1.**

Table 1. Range of Student Scores Per Category

Intervals	Category
85 – 100	High
75 – 84	Middle
0 – 74	Low

According to Sugiono, an interview is a meeting between two people to exchange information and ideas through questions and answers. So that meaning can be constructed in a particular topic (Sugiono, 2007). The interviews in this research are questions and answers between researchers and students to analyze the level of high-level thinking abilities and the obstacles faced by students related to high-level thinking abilities. The type of interview used is a semi-structured interview.

The interview used several core questions. In its implementation, the interview was carried out by asking questions freely, this was so that the research subjects felt comfortable and did not seem pushy. The choice of words is not standard but modified according to conditions (Sugiono, 2007). The type of interview used in this research is a semi-structured interview. Semi-structured interviews are freer compared to structured interviews. The purpose of this interview is to explore deeper information about students' high-level thinking abilities in solving algebra problems at SMP Negeri 10 Lhokseumawe.

The data analysis technique carried out after collecting data or information in the form of tests or interviews according to needs is narrative descriptive technique using the Miles and Huberman model with data reduction steps, data presentation and drawing conclusions. The results of this research data will be analyzed using the following steps:

Data Reduction

Reducing or changing data is carried out by selecting data, classifying data, and simplifying data. In this way, the reduced data can make it easier for researchers to carry out further data collection. The reduction stage in this research is collecting and formulating all data obtained from the field, namely:

1) Check students' ability test results.
2) Analyze test results based on predetermined indicators.
3) Identifying students' abilities in answering algebra questions.
4) Conduct interviews with students who have difficulty solving questions.

Data Presentation

After the data has been reduced, the next step is data presentation. Researchers present data which is the result of reduction from students' answer sheets to see where students have difficulties in solving exponentiation problems in algebra form and the results of interviews. The data that has been presented can make it easier for researchers to master and understand the data as a basis for drawing appropriate conclusions. The results of evaluation and interpretation can be in the form of an explanation of information regarding alternative actions that are considered appropriate, the obstacles faced and the reasons why these obstacles arise.

Drawing Conclusions

The next step in qualitative data analysis is drawing conclusions. Conclusions are obtained in the process of presenting data and need to be verified, namely testing the truth, strength and adjusting the meanings that emerge from the data. Conclusions are drawn from the beginning of data collection until the final data collection. “These conclusions were verified during the research. Verification takes the form of reviewing field notes or exchanging ideas between teachers (Miles & Huberman, 1992). Conclusions in this study refer to steps to see students' high-level thinking abilities in solving algebra problems. Drawing conclusions aims to describe students' high-level thinking abilities in solving problems in Algebra material.

3. RESULTS AND DISCUSSION

Results

Students' stages in determining high-level thinking abilities in algebra material, which includes aspects of analysis, evaluation and creation. The algebra test questions given are in the form of story questions. The test results that students have completed are analyzed based on indicators from aspects of high-level thinking abilities. The details of the indicators observed are:

Table 2. Aspects and Indicators of Higher Level Thinking Ability

No	Aspects of Higher Order Thinking Ability	Observed indicators
1	Analysis	Analyze known information from the problem posed. Identify/formulate questions.
2	Evaluation	Check the error or correctness of the problem
3	Create	1. Create a mathematical model. 2. Apply mathematical models

The results of the test carried out at SMP Negeri 10 Lhokseumawe in class VIII-1 as many as 24 students with algebra material in the form of descriptions of three questions showed that only 3 students answered correctly and perfectly and 21 other students answered with various errors. The following is the relationship between test questions and aspects of students' high-level thinking abilities

Table 3. Suitability of Questions and Aspects of Higher Level Thinking Ability

Question	Aspects
Question 1: A rectangular plot of land with a length of 5 m more than its width. Illustrate/Illustrate the problem of the question above.	Analysis
Problem 2: Based on question no. 1, If the width is 10 m, then the area of the land is…..	Create
Problem 3: To get the xyz value from the known equation below, can it be solved? A. $x^2yz^3 = 57$ B. $xy^2 = 55$ If it can be resolved, how is it resolved and if it cannot be resolved, give the reason.	Evaluation

Data from each student's high-level thinking ability test results are assessed and can be categorized as follows:

Table 4. Category of Higher Level Thinking Ability

Student scores	Higher Order Thinking Ability Category
$90 \leq$ value ≤ 100	Very high
$75 \leq$ value < 90	High
$60 \leq$ value < 75	Enough
$40 \leq$ value < 60	Low
$0 \leq$ value < 40	Very low

Based on the results of the student test, it shows that there are 3 students in the very high category or 12.5%, 3 students in the high category or 12.5%, 5 students in the moderate category or 20.83%, 9 students in the low category. or 37.5% and the very low category was 4 students or 16.67%. These results show that students still have difficulty in solving questions with high level thinking abilities. This can be seen in the low and very low categories, having a percentage of 54.17%.

The results of interviews with students showed that the questions given were difficult questions, and difficult questions like this had never been given by the teacher. The difficulties experienced by students vary, including difficulty understanding the questions, not understanding the question instructions, difficulty converting the questions into mathematical models, not understanding the initial concept of the material and not being able to apply the concepts in solving problems. This shows that mathematics teachers at SMP Negeri 10 Lhokseumawe, especially class VIII, still very rarely give questions to students who are thinking at a higher level. The importance of providing high-level thinking questions to students cannot be separated from the progress of the times, where nowadays people are needed who are able to think creatively, critically towards various information, able to analyze a problem and able to provide solutions to these problems. According to (Septianingsih et al., 2022) the aim of student level thinking abilities is to improve students' higher thinking abilities, which are related to the ability to think critically in receiving information, think critically creatively and be able to make decisions in urgent situations.

Researchers also conducted interviews with teachers to ask why students thought the questions the researchers gave were difficult. The interview results show that teachers still prioritize students' understanding of material concepts. Then give students exercises or homework, just to see how far the students understand the concept. Teachers assume that if students already understand the concept of the material being taught, then students will independently deepen the material with higher level issues. This shows that mathematics teachers still have not prepared the content in mathematics lessons, namely students' high-level thinking abilities.

Discussion

Aspects of Analytical Capability

The analytical ability aspect is found in question no. 1. The results obtained showed that 17 students could describe or illustrate the problem and 7 students could not.

Diagrammatically, it can be described as **Figure 1.**

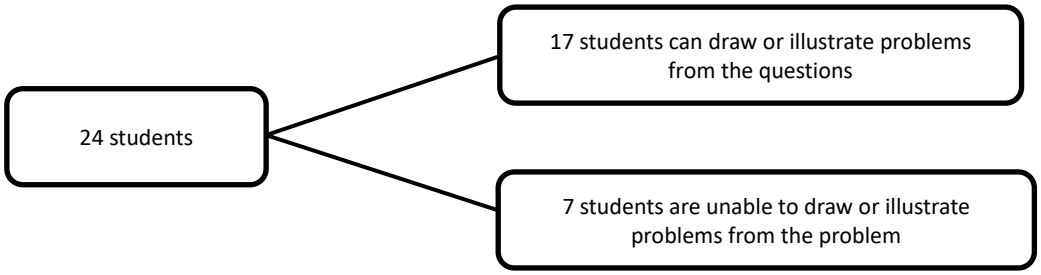

Figure 1. Results of Aspects of Analytical Capability

All students were able to describe a rectangle according to question 1, but the mistake made by 7 students was that they were unable to provide information on the length and width of the rectangular image. This is more caused by students not understanding the problem, students not being able to identify and describe information into mathematical models. thus causing errors in the length and width values of the rectangle. This is also confirmed by the results of interviews with students, namely that students do not understand the meaning of the words "length 5 m more than width" in the question. So this important information cannot be modeled by students to determine the length and width of the rectangle.

Aspects of Creation Ability

The aspect of creative ability is found in question No. 2, which is an explanation of result number 1, of course, students who are unable to explain the length and width values of a rectangle will not be able to answer question number 2. The results obtained showed that 8 students were able to create a rectangular formula according to the problem and were able to apply the formula in carrying out calculations. Meanwhile, 16 other students were unsuccessful in this aspect. However, of these 16 students, 4 students were able to create a formula, but made mistakes in applying the formula or calculations, 5 students were unable to apply the formula they had created and finally, 7 students were completely unable to create a formula for the problem.

Diagrammatically, it can be depicted as **Figure 2.**

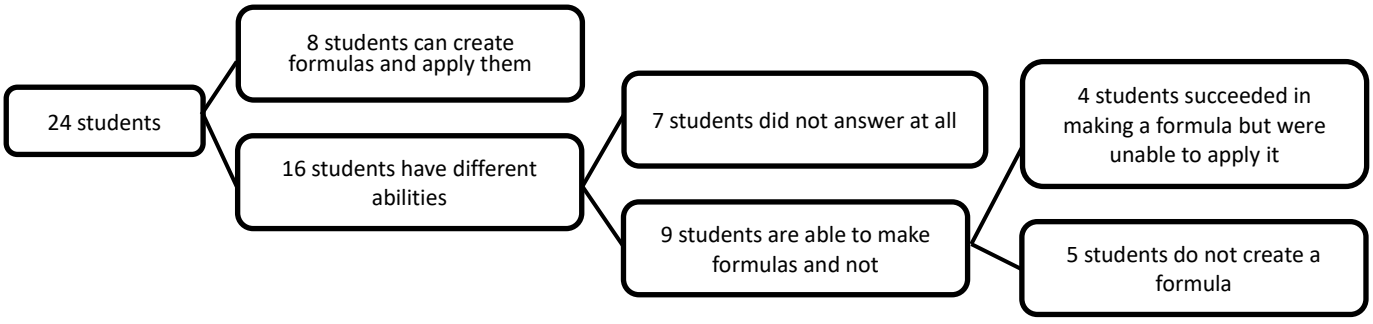

Figure 2. Results of Aspects of Creation Ability

The mistake made by students in this problem was that some students made the formula for the area of a rectangle, namely "pxl", which was theoretically correct, but the students did not substitute the p value for "l + 5". Some other students have made the formula correctly by substituting the p value so that the area of the rectangle becomes "(l + 5) xl" but the students are not able to explain this operation. The interview results showed that students did not understand algebraic operations as above, they said they were still confused about the operation of variables with variables and they also did not remember that the value l could be directly substituted for the value 10 as in the question, making calculations easier.

Aspects of Evaluation Capability

The evaluation of ability aspect is found in question no. 3. The results obtained were that 10 students were able to provide the right decision, but only 3 students were able to provide the correct solution and the other 7 students were unable to provide a solution to the decision. Meanwhile, 14 other students did not understand the questions at all.

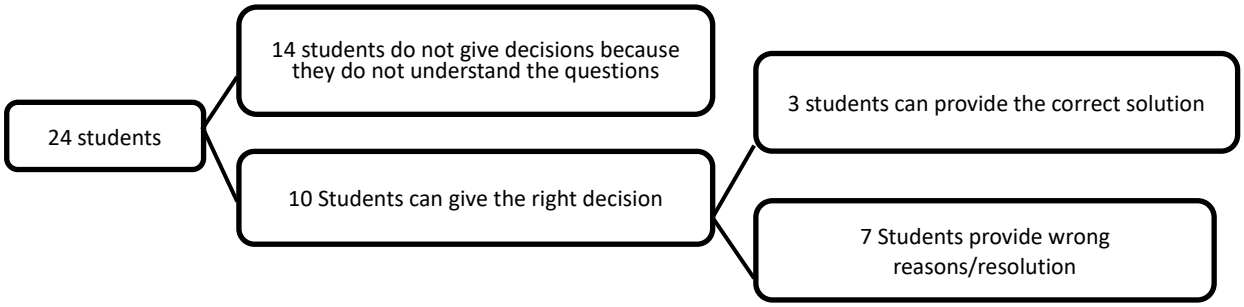

Figure 3. Results of Aspects of Evaluation Capability

For problem no. 3, is a problem that requires more precision and is a problem that is classified as difficult. In this case, more than half of the students do not understand the problem. While others tried to solve it but were unable to conclude that the two equations of problem no. 3 must be performed in a multiplication operation. Apart from that, they do not yet understand the operation of multiplying exponents for the same variables, which must be added. The interview results showed that they had never been given questions like no. 3, they have difficulty connecting equation 1 with equation 2 to get a solution, and they try to solve both equations by substitution and elimination, which, of course, will never get a solution.

4. CONCLUSION

Based on the research results and discussion of test result data on students' high-level thinking abilities it can be said to be still low, this is shown by the percentage of low and very low categories of 54.17%. The percentage of aspects of high-level thinking ability, namely the ability to analyze, is 70.83%, the ability to evaluate is 12.50% and the ability to create or be creative is 33.33%. This shows that students have been able to understand the problem but have not been able to solve the problem correctly. The results of interviews with students show that students are not yet familiar with non-routine questions, namely problems in the form of problem-solving. Students are emphasized more to understand the concepts of the material taught by the teacher. The problems tested in this research show that there are still many students who do not understand the concepts of algebraic shapes and operations.

CONFLICT OF INTEREST

There are no conflicts of interest declared by the authors.

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