

Analysis of Analytical Thinking Ability in Solving HOT Questions Based on Self-Directed Learning

Nurul Hikmah^{1*}, Nurimani¹, Nisa Permatasari¹
¹Mathematics Education, STKIP Kusuma Negara, Indonesia
[*nurulhikmah@stkipkusumanegara.ac.id](mailto:nurulhikmah@stkipkusumanegara.ac.id)

Abstract

This research aims to analyze students' analytical thinking skills in solving HOTS (Higher Order Thinking Skills) questions regarding three-variable linear equation systems in terms of self-directed learning. This research used a qualitative approach with a descriptive type of data collection using observation, interviews and documentation. The respondents in this research were 20 students in class X Accounting at SMK Gelora Bekasi. The research results are described in the form of analytical thinking ability test results and interviews conducted by researchers with research subjects. From the research results, there were 3 students in the high category, 8 students in the medium category, and 9 students in the low category. Two types of data were collected in this research, namely the first data in the form of written tests, self-directed learning questionnaires and the second data in the form of interviews.

Keywords: Analysis, analytical thinking ability, self-directed learning

1 INTRODUCTION

Education is a basic need for every human being. Therefore, educational reform must be implemented to improve the quality of education (Usman, A. S. 2014). At school there are many subjects that students have to study, especially mathematics. Mathematics is a mandatory subject for education, especially in Indonesia, to develop the ability to count, measure and use mathematical formulas in everyday life, so that students are expected to be able to apply mathematical concepts in time management. (Pratiwi, J. W., & Pujiastuti, H. 2020). In the mathematics learning process it is associated with formulas, numbers and other arithmetic operations. Therefore, mathematics is a field of study that is less popular with students. This causes students' level of thinking and students' grades to be very low compared to other subjects. One of the abilities in the thought process that is important in solving mathematics is the ability to think analytically. The ability to think analytically in learning mathematics is an ability that students must have to solve a problem correctly.

As time went by, the government began to place Higher Order Thinking Skills (HOTS) type questions into class assessments and school exams. HOTS (Higher Order Thinking Skills) questions are a type of question designed to measure students' ability to think at a higher level. Higher Order Thinking Skills include the ability to think critically, logically, analytically and creatively. In mathematical problem solving abilities, there are aspects that influence success and help students in solving problems, one of which is the affective aspect, namely self-directed learning (Sucipto, S. 2017). Self-directed learning can be interpreted as the initiative of students who are not dependent on other people, can determine learning goals, determine relevant learning sources, form study schedules, and determine effective learning strategies. (Nurdyansyah, N., & Fahyuni, E. F. 2016). If students do not have self-directed learning, then students will have difficulty in the learning process, and continue to rely on other people without trying themselves. By applying self-

directed learning skills, students can be successful in their learning and their abilities will continue to develop.

In this research, the indicators used are differentiating, organizing and providing attributes. The distinguishing indicator can be said to be achieved if one is able to correctly state all the information contained in the HOTS questions in the form of known and asked equations. Organizing indicators can be said to be achieved if they are able to state the mathematical form of the information obtained correctly and its application using various variables (Ansari, B. I., & Abdullah, R. 2020).

Indicators providing attributes are said to be achieved if they are able to state the settlement method used and explain the settlement method correctly. If the results of the analysis of the tests and interviews achieve the indicators, it can be concluded that the subject has achieved the indicators. Then if the results of the test analysis show achievement while the interview analysis shows the results are not achieved, then it can be said that the subject in the related indicators does not meet the achievement because the results obtained may not be pure work on the subject. Finally, if the results of the test ability analysis show that it is not achieved and the results of the interview analysis are achieved, then it can be said that the subject may have run out of time or made a mistake in writing.

The purpose of this research is to determine students' analytical thinking skills in solving HOTS (Higher Order Thinking Skills) questions regarding three-variable linear equation systems in terms of self-directed learning.

2 RESEARCH METHODS

The place for carrying out this research is SMK Gelora Bekasi which is located at Jl.Perjuangan Kp.Irian, RT.003/RW.003, Teluk Pucung, North Bekasi District. This research was carried out in the even semester on May 30 2024 for the 2023/2024 academic year. The subject matter chosen in this research is "System of Linear Equations with Three Variables" which is material in the class X syllabus taught in the even semester. This research describes students' analytical thinking skills in solving HOTS (Higher Order Thinking Skills) questions regarding three-variable linear equation systems in terms of self-directed learning.

In accordance with the title taken by the researcher, the approach to this research is qualitative descriptive research, which is research that produces data in the form of descriptions, written or spoken words of a person or behavior that can be observed. Researchers use qualitative research because it makes it possible to analyze analytical thinking skills in solving HOTS questions for class. In the context of this problem, when compared with non-qualitative approaches, the qualitative descriptive approach is certainly more suitable for obtaining holistic descriptions based on collection of oral or written data.

The data taken in this research are the results of students' answers to the analytical thinking ability test instrument, then analyzed by calculating or summing the students' scores and the total score is then obtained by students in the high, medium and low categories.

Data triangulation carried out in this research took the form of: Comparing the results of analytical thinking ability tests in solving HOTS questions and interview results. Comparing research findings on analytical thinking skills in solving HOTS questions and interview results with previous research results. Interviews were conducted with students who had studied the material on three-variable linear equation systems (Lestari, I. 2021).

3 RESULTS AND DISCUSSION

The data from this research is the ability to think analytically in solving higher order thinking skills (HOTS) questions on three-variable linear equation systems in terms of self-directed learning which includes differentiating, organizing and assigning attributes. Data analysis was carried out based on the results of written tests and analytical thinking ability interviews with informants from each self-directed learning category. The questions that will be analyzed are essay questions number 2, 3, and 5. This is because questions number 1, 2, and 4 have question forms and solutions that are similar to each other. In addition, the answers given in both tests and interviews tend to be similar. So the answers given to questions number 2 and 4 are represented by the answers to question number 1. The essay questions were validated by 2 STKIP Kusuma Negara lecturers, namely Mrs. Siti Syifa Fajar Tirta Lestari, M.Pd and Mr. Abdul Hakim Ma'ruf, M.Pd with 1 mathematics subject teacher who teaches in class X Accounting, namely Mrs. Henisah Pasaribu, S .Pd. From the results of the criticism or input from the validator, the essay questions you want to give must be made varied with example questions using comparisons and percentages related to the material and indicators. The research was conducted by giving HOTS questions in the form of essay questions with a time of 60 minutes to 20 students with a total of 5 questions.

After the students completed the questions given, the researcher checked the results of the subject's answers to identify analytical thinking abilities from the analytical thinking ability assessment criteria and analyzed the students' answers according to the indicators. Next, interview students with high, medium and low level thinking abilities, 2 students each and conduct interviews regarding the overall questions with 20 students.

Table 1. Analytical Thinking Ability Test Results

Data Size	Scoring
Rata-Rata	70
Highest Score	85
Lowest Score	29
n (number of samples)	6

To see the centrality of the data, the test results are reduced to 3 categories or ranges as in the following table.

Table 2. Category of Student Ability Level

Rating Scale	Student Ability Level
$80 \leq \text{value} \leq 100$	High
$60 \leq \text{value} < 80$	Currently
$0 < \text{value} < 60$	Low

Based on the research results obtained from students in class This agrees with research conducted by Suraji et al., it was explained that there was a lack of student response and a tendency to memorize rather than understand concepts (Suraji, S., Maimunah, M., & Saragih, S. 2018).

Based on the results of analysis of written tests and interviews conducted with subjects with high abilities in solving HOTS questions in terms of self-directed learning. The first indicator is differentiating the problem. In questions number 1, 3, and 5, subjects 1 and 2 were able to identify what was known and asked about the questions correctly even though the subjects had to read them repeatedly. Thus, high-ability subjects do not experience difficulty in distinguishing problems. This is in line with Wulandari et al's research that subjects with high logical-mathematical intelligence are able to differentiate and understand problems well. The subject is able to express what is known and asked appropriately. Apart from that, the subject is also able to reveal information that is not yet in the question to help solve the problem (Wulandari, S. P. 2016, February).

Next, the second step is organizing problem solving. In questions number 1, 3, 5 subjects 1 and 2 can create mathematical models into the form of appropriate SPLTV mathematical equations and can use known information to adjust new information. Thus, high-ability subjects do not experience difficulties in organizing problem solving. This is in line with Indarwati et al that at this stage students must look for concepts or theories that support each other and look for the necessary formulas. (Indarwati, D., Wahyudi, W., & Ratu, N. 2014).

The third step is to provide solution attributes. Subject 1 in questions number 1, 3, and 5 can complete the solution using the solution method, namely elimination and substitution into a mathematical model correctly in solving the problem. However, in question number 5, the subject of the test results was that the subject was able to complete the solution using the solution method. When confirmed again, the subject could not name mathematical equations. Thus, the type of difficulty experienced by high ability subjects in providing problem solving attributes is difficulty in solving verbal questions.

Based on the results of the analysis of written tests and interviews conducted with subjects with moderate abilities in solving HOTS questions in terms of self-directed learning. The first step is to differentiate the problem. Subjects 1 and 2 in questions number 1, 3, 5 were able to identify what was known and asked about the questions correctly. Thus the subject does not experience difficulty in distinguishing problems. This is in line with Yani's research that subjects with moderate logical-mathematical intelligence are able to understand problems well. Subjects are able to reveal information that is not yet in the question to help solve the problem (Yani, M., Ikhsan, M., & Marwan, M. 2016) .

The second step is organizing the problem. Subjects 1 and 2 in questions 1 to 5 can make mathematical concepts into the appropriate SPLTV method and can use known information to adapt new information. Thus the subject does not experience difficulty in organizing the problem.

The third step is to provide attributes. Subject 1 in question number 1 is a moderately capable subject who can substitute known values into mathematical models and be precise in calculating problem solutions. In questions number 3 and 5, the subject was correct in substituting known values into the mathematical model, but the subject was unable to calculate the solution to the problem. Thus, the type of difficulty experienced by the subject is difficulty in using principles.

Meanwhile, subject 2 in questions number 1 and 3 can substitute known values into a mathematical model and be precise in calculating the solution to the problem. In problem number 5 the subject was correct in substituting known values into the mathematical model, but the subject was unable to calculate the solution to the problem. Thus, the type of difficulty experienced by moderately capable subjects in organizing equations is principle difficulty.

Based on the results of analysis of written tests and interviews conducted with subjects with low abilities in solving HOTS questions in terms of self-directed learning. The first step is to differentiate the problem. Subjects 1 and 2 in question number 1 were able to identify what was known and asked about the question. Thus, low ability subjects do not experience difficulty in distinguishing problems. In question number 3, subject 1 was able to write down all the information from question number 3, but when reconfirmed the subject did not understand and was confused about stating the mathematical equation. Thus, the type of difficulty experienced by subject-1 in the distinguishing indicator is difficulty in using the concept. Furthermore, subject 2 in question number 3 on the distinguishing indicator shows that the subject wrote down the information contained in question number 3 in good mathematical form, but did not write down what was asked in the question. Thus, the difficulty experienced by subject-2 with low ability in the differentiation step is difficulty in using concepts. In question number 5, subject 1 was able to write down what he knew and asked well. Thus, subject 1 with low ability did not experience difficulty in distinguishing indicators. Subject 2 in question number 5 shows that the subject did not write down any answers related to the information or mathematical form of the equation contained in

question number 5. Thus the type of difficulty experienced by subject-2 with low ability in differentiating indicators is a type of difficulty in using principles.

The second step is organizing. In question number 1 the subject was able to write down the form of the equation with the variables used in the question well, but when confirmed again during the interview the subject had to read the question repeatedly to organize the equation. Thus, the type of difficulty experienced by subject-1 with low ability in organizing indicators is a type of difficulty in expressing concepts. Subject 2 in question number 1 was able to form the mathematical equation known in the question. Thus subject 2 in the organizing step did not experience difficulties. In question number 3, subjects 1 and 2 were able to form the mathematical equation contained in question number 3. Thus, subjects 1 and 2 did not experience difficulties in the organizing step. In question number 5 subjects 1 and 2 were unable to write what they knew and were asked into mathematical form properly and correctly. Thus, the type of difficulty experienced by subjects 1 and 2 with low ability in organizing indicators was difficulty in solving verbal questions.

The third step is to provide attributes. In question number 1, subject 1 was able to write down the form of the equation known in the question, but when it was confirmed again, the subject had to read the question repeatedly to organize the equation. Then, the subject completes the problem before discussing it with a friend or looking at the method in a book. Thus, the type of difficulty experienced by subject 1 with low ability in the indicator of providing attributes is difficulty in using concepts. Subject 2 in question number 1 was able to solve the problem in the question using one of the solution methods, namely elimination. Thus, there were no difficulties experienced by subject 2 with low ability in providing attribute indicators. In question number 3, subjects 1 and 2 showed that they were not complete in writing the equation in the problem, but when confirmed again the subject was able to explain the solution to the method. Thus, the type of difficulty experienced by subjects 1 and 2 with low ability in the indicator of giving attributes in question number 3 is difficulty in using principles. In question number 5 subjects 1 and 2 showed that they were not complete in writing the equation in the question, and when confirmed again the subject was unable to explain the solution to the method in the form of a mathematical equation. Thus, the type of difficulty experienced by subject 1 in question number 5, the indicator provides an attribute, namely difficulty in using principles.

4. CONCLUSION

The level of analytical thinking ability possessed by each student is different, this can be triggered by several things, including the category of thinking, intellectual intelligence, lack of accuracy, lack of understanding of the material and so on. This creates differences in students' levels of understanding according to the self-directed learning category.

Analysis of the data and discussion carried out by the researcher means that the researcher can describe several types of difficulties experienced by students, namely difficulties in using concepts, for example students forget the abbreviation or technical name of an object, difficulties in using principles, namely students cannot use principles because of the clarity of the principles. The reason for the difficulty in solving verbal questions is not understanding what is read due to students' lack of knowledge about concepts or unknown terms, not being able to determine variables to compose equations, and so on.

5. REFERENCES

- Ansari, B. I., & Abdullah, R. (2020). *Higher-order-thinking skill (HOTS) for millennials through mathematics learning innovation*. IRDH Book Publisher.
- Indarwati, D., Wahyudi, W., & Ratu, N. (2014). Increasing mathematical problem solving abilities through the application of problem based learning for fifth grade elementary school students. *Satya Widya*, 30(1), 17-27.

- Lestari, I. (2021). Analysis of Students' Mathematical Problem Solving Ability in Solving High Order Thinking Skill (HOTS) Problems on Set Material during the Covid 19 Pandemic (Doctoral *dissertation*, IAIN Ambon).
- Nurdyansyah, N., & Fahyuni, E. F. (2016). *Innovation in learning models according to the 2013 curriculum*.
- Sucipto, S. (2017). Developing high-level thinking skills using metacognitive strategies, problem based learning models. *JP (Journal of Education): Theory and Practice*, 2(1), 77-85.
- Suraji, S., Maimunah, M., & Saragih, S. (2018). Analysis of the ability to understand mathematical concepts and mathematical problem solving abilities of junior high school students in the material of systems of linear equations in two variables (SPLDV). *Suska Journal of Mathematics Education*, 4(1), 9-16.
- Usman, A. S. (2014). Improving the Quality of Education Through the Implementation of School-Based Management. *DIDACTIC scientific journal*, 15(1), 13-31.
- Pratiwi, J. W., & Pujiastuti, H. (2020). Ethnomathematical exploration of the traditional game of marbles. *Rafflesia Journal of Mathematics Education*, 5(2), 1-12.
- Wulandari, S. P. (2016, February). SPLDV problem solving profile with Polya steps in terms of students' mathematical logical intelligence. In *PRISMA, Proceedings of the National Mathematics Seminar* (pp. 724-732).
- Yani, M., Ikhsan, M., & Marwan, M. (2016). The thinking process of junior high school students in solving mathematical problems based on Polya's steps in terms of the adversity quotient. *Journal of Mathematics Education*, 10(1), 43-57.