

## ***ANALYSIS OF MATHEMATICAL PROBLEMSOLVING ABILITY BASED ON HOTS QUESTIONS ON SEQUENCES AND SERIES MATERIAL REVIEWED BASED ON POLYA STAGES***

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### **ABSTRACT**

The purpose of this study is to describe mathematical problem solving ability in solving HOTS type questions on the material of sequences and series which are reviewed based on stages according to Polya. The type of research used is qualitative research. Sampling was done by using purposive sampling technique. The results showed that students with high categories were good problem solvers and students with low categories were inexperienced problem solvers. Meanwhile, students with moderate category can be grouped into good problem solvers and routine problem solvers. The limitation of this research is the limited material where the HOTS questions used only contain one HOTS cognitive level and contain four indicators of problem solving ability according to Polya. Overall, the HOTS type questions used can improve students' mathematical problem solving abilities. Students with good problem solving skills are able to reach the HOTS cognitive level and are able to meet the four indicators of problem solving ability according to Polya. Meanwhile, students with inexperienced problem solvers are unable to reach the HOTS cognitive level and are unable to meet the four indicators of problem solving ability according to Polya. It can be concluded that there is a correlation between students' mathematical problem solving abilities and the HOTS type questions used. It is expected that students should practice more frequently on questions that require higher order thinking skills (HOTS) so that their mathematical problem solving abilities can increase.

**Keywords:** HOTS type questions; Mathematics Education; ICOMET

### **1. Introduction**

Mathematics learning directs students to think logically and think creatively and be able to work together and collaborate in solving problems in everyday life. According to NCTM, (2000) "all students must build mathematical knowledge through problem solving. This is because in the problem solving process, students will try to recognize a concept that has not been known before and can make learning mathematics a learning experience for the next stage. Problem solving ability is able to develop students' thinking skills in order to solve a problem in accordance with the existing problem solving steps. As stated by (Polya, 1973) that

there are four steps to solving problems, including: 1) Understanding the problem, 2) Planning for problem solving, 3) Implementing a problem-solving plan, and 4) Re-examining the solution obtained. The findings of the Trends International Mathematical and Science Study (2019) show that Indonesia is ranked 45th out of 50 countries. The survey results are a stimulus that requires an effort to improve the learning process in mathematical problem solving abilities. One of the factors that causes the ability to solve mathematical problems in Indonesia is still low, namely the lack of accuracy of students in solving problems that are analytical, creative and require high-level thinking skills called HOTS questions. Preliminary studies conducted

obtained results that students still consider mathematics as one of the feared subjects because students have difficulty in solving these problems. This greatly affects the problem solving ability of students who are still relatively low. According to (Lestari et al., 2019) problem-solving abilities are closely related to students' understanding. Researchers are interested in conducting a study on how students' mathematical problem solving abilities are reviewed based on the Polya stages. The goal is that students can improve their problem-solving abilities and hope that learning achievement in mathematics can be improved. One of the basic materials learned in learning activities is the material of sequences and series that can be collaborated into HOTS type questions. Based on the above background, the researcher will conduct a study on "**Analysis of Mathematical Problem Solving Ability Based on HOTS Questions on Sequences and Series Materials Reviewed Based on Polya Stages**".

## 2. Research Methods

This study uses a qualitative approach with qualitative descriptive research. Qualitative descriptive research is used to facilitate researchers in presenting research results in the form of descriptive text, making it easier to understand. Sampling was carried out using the purposive sampling technique by grouping the results of the work of research subjects in solving HOTS type questions. The grouping of the results of the work will be divided into three categories, namely high, medium and low. The procedures carried out are as follows.

1. The planning stages consist of :
  - a. Formulate the problem.
  - b. Conduct a preliminary study.
  - c. Develop a research design.
  - d. Develop research instruments.
  - e. Conducting trials of research instruments.
  - f. Determine the research subject.
2. The stages of research implementation consist of :
  - a. Collecting data from tests of mathematical problem solving skills in solving HOTS type questions.

- b. Collect additional data from interviews with selected research subjects.
- c. Perform data processing and data analysis.

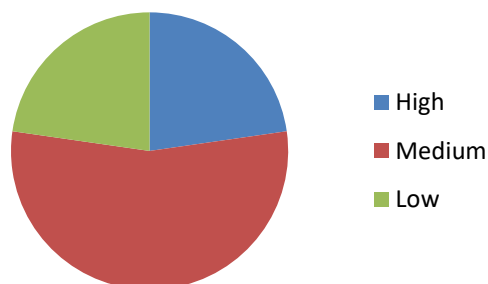
According to Patton (in Awaliyah, 2016) there are no rules for the size of sampling in qualitative research. The determination of research subjects is based on the final results of the answers to the mathematical problem solving ability test with HOTS type questions by the research subject. The HOTS type of questions used contain one cognitive level for each question, including: (1) Questions number 1 and number 2 measure the realm of analyzing (analyze-C4), (2) Question number 3 measures the realm of creating (create-C6) and (3) Questions number 4 and number 5 measure the realm of evaluating (evaluate-C5). The instrument of the test questions will be tested on other students, in addition to the research subjects to determine the level of validity of the questions. Furthermore, it is carried out by the research subjects who have been determined. The final results of the answers that have been obtained are divided into three categories, namely high, medium and low based on the standard deviation. According to Arikunto (in Awaliyah, 2016) standard deviation is the determination of the position by dividing the class into several groups. The steps to determine the three categories are as follows.

- a. Summing up the scores obtained by all students ( $\sum X$ )
- b. Find the average score ( $\bar{x}$ ) and standard deviation (SD) using the following formula.
$$\bar{x} = \frac{\sum X}{N}$$
$$SD = \sqrt{\frac{\sum X^2}{N} - \left(\frac{\sum X}{N}\right)^2}$$
- c. Determine the category of mathematical problem solving ability  
High :  $X > \bar{x} + SD$   
Medium :  $\bar{x} - SD \leq X \leq \bar{x} + SD$   
Low :  $X < \bar{x} - SD$

## 3. Results and Discussion

Based on the results of research and data analysis regarding students' mathematical

problem solving abilities in solving HOTS type questions on the material of sequences and series which are reviewed based on Polya stages, the results show that the HOTS questions used can improve students' mathematical problem solving abilities which are presented in picture 1. below .



Picture 1 . Results of research on mathematical problem solving ability

Research subjects with high categories obtained results that the research subjects were able to meet all the indicators of problem solving abilities according to Polya and were able to reach the cognitive level of HOTS questions. Research subjects with high categories include good problem solvers (Mairing, 2018). The characteristics of good problem solvers according to (Mairing, 2018) have been shown by research subjects by obtaining high scores at each stage of problem solving according to Polya and being able to re-examine the solutions obtained.

Research subjects in the medium category obtained the results that the research subjects were only able to meet the three indicators of problem solving ability according to Polya and only able to meet the cognitive levels of analyzing (analyze-C4) and evaluating (evaluate-C5). Selected research subjects in the medium category include routine problem solvers and good problem solvers (Mairing, 2018). The characteristics of routine problem solving according to (Mairing, 2018) have been shown by research subjects who have made no attempt to re-examine the solutions obtained.

Research subjects in the low category obtained the results that the research subjects were unable to meet the four indicators of problem solving ability according to Polya and were unable to achieve three cognitive levels of HOTS questions. The research subjects included inexperienced problem solvers (nave problem

solvers) (Mairing, 2018). The characteristics of inexperienced problem solvers according to Mairing (2018) have been shown by research subjects who make mistakes at several stages of problem solving.

The limitation of this research is only to measure mathematical problem solving ability in solving HOTS type questions which are reviewed based on Polya stages. The HOTS type questions used only contain one HOTS cognitive level for each question. Each cognitive level contained in the test questions is only to find out the type of questions used.

#### 4. Conclusions

Overall, the HOTS type questions used can improve students' mathematical problem solving abilities. It can be seen that students who have high category mathematical problem solving abilities can complete test questions by meeting all indicators of problem solving abilities and can meet all cognitive levels of HOTS questions. Meanwhile, students in the low category cannot complete the test questions and do not meet all the indicators of the stages of problem solving abilities. Students with low categories are also not able to meet all cognitive levels of HOTS questions.

There is a correlation between problem solving ability and the type of HOTS used. The findings of the research conducted showed that not all research subjects with moderate problem-solving abilities were routine problem solvers. This is indicated by the existence of research subjects who are able to meet the indicators of problem solving abilities according to Polya. It is hoped that further research will use quantitative research methods, because this research uses qualitative descriptive research methods. Students should practice questions more often that require higher-order thinking skills so that their mathematical problem-solving abilities continue to increase. It is also necessary to do further research on mathematical problem solving abilities in solving HOTS type questions that measure three cognitive levels on each HOTS question used, because researchers only measure one level for each question used.

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## 6. References

- Arikunto, S. (2000). *Research Procedures: A Practical Approach*. Jakarta : Rineka Cipta.
- Awaliyah, F. (2016). Analisis Kemampuan Pemecahan Masalah Siswa Kelas X SMA Materi Trigonometri dalam Pembelajaran Model *Auditory Intellectually Repetition* (AIR). *Under Graduates Thesis*, Universitas Negeri Semarang. <http://lib.unnes.ac.id/25245/>
- Lestari, K. S., Nurjanah, S., & Zanthi, L. S. (2019). Analisis Kemampuan Pemahaman dan Pemecahan Masalah Matematik Siswa SMPN 36 Bandung pada Materi Persamaan Linear Satu Variabel. *Jurnal Pembelajaran Matematika Inovatif*. 2 (3), 107–118.
- Mairing, J.P. (2018). *Mathematical Problem Solving*. Bandung : Alfabeta.
- National Council of Teachers of Mathematics. (2000). *Principles and Standards of School Mathematics*. Rest. VA : National Council of Teachers of Mathematics, Inc.
- Polya, G. (1973). *How to Overcome It*. New Jersey: Princeton University Press.